LESSONS ON MASSAGE

MARGARET D. PALMER

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BY

MARGARET D. PALMER

MASSEUSE AND MANAGER OF THE MASSAGE DEPARTMENT OF THE LONDON HOSPITAL
INSTRUCTOR OF MASSAGE TO THE NURSING STAFF OF THE LONDON HOSPITAL
MEMBER OF THE COUNCIL OF THE INCORPORATED SOCIETY OF TRAINED MASSEUSES

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PREFACE

At the earnest and oft-repeated request of my pupils, I publish my lessons on massage, in the hope that they and others will find them as useful as they anticipate. The instructions given are founded upon the results of many years' experience, both in teaching and in practical work.

I have culled from standard works on anatomy and physiology what is indispensable for the pupil masseuse to study, that she may have under one cover sufficient information on these subjects to enable her to learn her work intelligently, without burdening her memory with unnecessary details, and to have, later on, a handy book of reference.

Use has been made of the following works on anatomy and physiology: Quain, Ellis, Cunningham, Sparkes, Starling, Furneaux.

MARGARET D. PALMER.

44, Gray Coat Gardens,
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LESSONS ON MASSAGE

CHAPTER I

THE HISTORY OF MASSAGE

From the earliest times rubbing of some sort has been used for curative purposes. It is known to have been employed by the Chinese as far back as 3000 B.C. It was probably from them that the Japanese learnt the art, which is still much used by both.

Greeks, Romans, Turks, Egyptians, Hindoos and Persians, have always practised a sort of massage.

Well-known names along all the centuries are connected with it.

Herodicus, 500 B.C., the founder of Medical Gymnastics, compelled his patients to have their bodies rubbed.

Hippocratus, 460 B.C., said the physicians should be experienced in rubbing, 'for things that have the same name have not always the same effect. For rubbing can bind a joint that is too loose, and loosen a joint that is too rigid.' 'Rubbing can make flesh, and cause parts to waste.'

Asclepiades, a Greek physician, 128 B.C., used rubbing combined with active movements.

Julius Cæsar, 100 B.C., had himself pinched all over every day as a means of getting rid of neuralgia.

Celsus, a Roman physician, at the beginning of the Christian era, advised that friction should be used several times a day in the sun, and found that 'chronic pains in the head are relieved by rubbing the head itself,' and that 'a paralyzed limb is strengthened by being rubbed.'

Galen, A.D. 130, Physician to the School of Gladiators at Pergamos, as a preparation for the exercises, ordered the bodies of the combatants to be rubbed till they were red and then anointed.

Ambrose Paré, A.D. 1575, described 'gentle, medium, and vigorous friction,' and the effects of each, and recommended that in dislocations joints should be moved about 'this way and that way' in order to resolve the effused fluids so as to facilitate reduction.

Hoffman, Physician to the King of Prussia about 1700, recommended rubbing and exercises.

Two hundred years ago the French used massage extensively. Then it is heard of among the Scandinavians and Germans, by whom it was scientifically worked out. Mr. Grosvenor, a Surgeon at Oxford, in the early part of 1800, became famous by his success in curing stiff joints by friction. About the same time or later Mr. Balfour, of Edinburgh, treated rheumatism, gout, sprains, etc., by rubbing, percussion, and compression. In 1813 the Royal Central Institute was established at Stockholm, and Peter Henry Ling introduced his system of movements. He was not the originator of the Swedish movements, but he systematized them. They were divided by him into passive, active, and resistive movements.

The passive movements include manipulation of the muscles; many of the movements used now in massage were used by Ling. The movements done *on* the body and those done *with* a part of the body, such as flexion and extension of a limb, are both passive movements, but in this country it is the custom to divide them, and to speak of the former as massage, and the latter as passive or Swedish movements. It must not be supposed that in using these movements in connection with massage there is any pretension to the Swedish movement cure. Exercises of all sorts are now very much used, and there are several systems, but all are based on Ling's system.

Active movements are those done by the patient's own effort.

Resistive movements are performed by the patient while the operator resists, or a part of the patient's body is moved by the operator while resistance is given by the patient. A resistive movement is of course also an active movement.

Passive movements act chiefly on the joints and on blood-vessels, lymphatics and nerves connected with them.

Active and resistive movements act on the muscles in a greater degree, the will of the patient being brought to bear on the movement.

It remained for Dr. Mezger, of Amsterdam, to revive massage, and put it on a scientific basis; he practised it in 1860, and some years later was brought into prominence by his cure of the then Danish Crown Prince, who had suffered from a chronic joint affection.

Professors Von Mosengeil, Berghman and Helleday, pupils of Dr. Mezger, made many experiments, and from this time (1860 to 1874) massage became a recognised treatment everywhere.

In 1877 Dr. Weir Mitchell, an American neurologist, had proved its usefulness as an auxiliary in his treatment of hysteria, and was instrumental in introducing it into this country. Since then it has been taken up by the leading physicians and surgeons.

Many other names might be mentioned; the above are sufficient to show how massage has been handed down from the earliest times, and that it is not, as one still often hears, a 'new treatment.' During the last few years some books on the subject have been published in this country, notably those by Dr. Stretch Dowse, Dr. W. Murrell, and Dr. S. Eccles, which should be studied by every masseuse.

Massage is not a panacea for every ill, but it has proved to be a good remedy in cases in which it is indicated, and they are neither few nor far between.

It is now more used and on a better footing as a remedial agent than it has ever been.

The shampooing done in a Turkish bath is not massage; it is pleasant and useful, but it is not scientific, and is done by persons who have no knowledge of anatomy; nor is it necessary they should have, but to do massage properly and to be able to follow intelligently the directions of the medical man, some knowledge of anatomy is essential.

MASSAGE.

The name is derived from a Greek word signifying to knead, and an Arabic word meaning to press; it comes to us through the French, and is the scientific manipulation of the soft tissues of the body.

The skin and muscles are stroked, kneaded, squeezed, rolled and tapped, with the result that

(*a*) The functions of the skin are improved;
(*b*) The flow of blood and lymph is quickened;
(*c*) Blood is attracted to the surface from internal parts;
(*d*) Nerves are stimulated or soothed as the case may be;
(*e*) Effete matter is got rid of;
(*f*) Adhesions of soft parts are broken down;
(*g*) Swelling and thickening of tissues are reduced;
(*h*) Nutrition is increased.

In giving general massage, if the patients are received at the house of the operator, a suitable couch should be provided, say 2 feet wide, comfortably padded, and about 26 inches high; the room should be kept at a proper temperature, between 65° and 70°.

In visiting the patient at her house, she would probably be in bed, which might be of an inconvenient height, and the room of a temperature preferred by the patient rather than approved by the masseuse. In such a case the latter would have to fit herself into the circumstances. The patient's comfort and benefit must always be the first consideration, but the masseuse should also make herself as comfortable as possible, so that she may do her best work. The nightdress need not be removed; it is well to have an extra blanket or sheet laid crossways on the bed under the lower limbs, that each leg may be wrapped up separately; this protects the leg which is not being worked on from draught and cold. Some patients like to wear a flannel dressing-gown, in which case the extra covering is not required, as the legs may be separately wrapped in the gown. Others like a massage suit; there is no reason why their tastes should not be gratified; the point is to keep them warm and well covered, no part exposed except that which is being manipulated. It is well to have a small soft shawl to throw over parts which might otherwise not be sufficiently covered. Hot-water cans are not a necessity, and should not be introduced if the patient has not been accustomed to them; if she has been, they must be continued, as it is not well to make changes, otherwise massage should be depended upon to give warmth. If the feet are habitually cold, it is a good plan to put on bed-socks after the feet have been manipulated, to keep up the heat generated by the massage. In heart cases hot-water tins are used, not only to the feet but about the body, and it is important that they should be replaced as each part is finished.

When the lower limbs have been manipulated, they are wrapped up and the bedclothes folded back to the hips, the nightdress being raised to get at the abdomen. The chest comes next, to get at which the hands can be slipped under the nightdress.

In doing the arms, one sleeve is taken off at a time, and replaced.

The patient is then turned and the séance completed by massage of the back. This order need not always be followed: the arms may be left till last, or the first movements may be on the abdomen.

In massage of the abdomen only, the nightdress is turned up above the region of the liver and the bedclothes are turned down to the hips.

For the back only, a jacket is worn, with the opening at the back, thus covering the arms and chest.

Scarcely too much stress can be laid on the *manner* of doing massage. As a rule the operator faces the patient, and should stand or sit at a comfortable distance, so as to be neither cramped nor strained; in most movements the elbows are kept close to the sides, but not stiffly, the fingers held close together and straight; unnecessary stooping is to be avoided. The body should not be swayed nor the head moved up and down, keeping time, as it were, to the movements. No part of the operator's body (or the patient's) should be rigid.

It is imperative that there should be no jerking; the hands should not be lifted suddenly from the patient's body; the operator should not lose contact unnecessarily with the patient, but glide almost imperceptibly from one movement to another.

All this is not as simple as it sounds, for pupils often have difficulty in overcoming these little things. It is only by attention to details and constant practice that the expertness and rhythm so necessary to pleasant and successful massage is acquired.

The eye and hand must be trained to at once notice everything about a patient—the condition of the skin, muscles, joints, etc.; no remark need be made, but mental notes taken which may be useful later on or even at the moment, as the character of the work is influenced by the condition of the tissues: roughness of skin, matting and hardness of fascia and muscles, fulness of veins, grating of joints, would each call for special work.

During a course of massage the masseuse should immediately be struck, on touching the patient, by increased heat of the skin, and for her own satisfaction take the temperature. The normal temperature of the body is 98·6° F.; a trifling variation need cause no alarm, but a rise to 99·6° or 100° would indicate that massage should be suspended till the doctor had seen the patient.

It is not necessary to enforce silence during the séance, nor must the masseuse suppose it is her business to talk to and amuse the patient; she should answer all questions cheerfully (and wisely), and be ready to give any information she can. It is unnecessary to say to intelligent workers that gossip and the details of the illness and treatment of other patients should be avoided.

Care should be taken to get the hands into proper working order, and to keep them nice. Pupils cannot do better than to mass their own hands; it will make them soft and supple; every joint must be manipulated and the muscles of the palm well worked up. It is most important to train the left hand; most persons are, unfortunately, very right-handed; in massage both hands are needed, and it takes much practice to make the left hand as expert as the right.

Lubricants are not necessary except under special circumstances. Some persons cannot mass without some greasy substance, because their hands are damp or coarse, or they are clumsy in the use of them; but given dry, soft hands, and the knowledge of how to use them, no fear need be entertained of causing rashes or abrasions. It is only in the stroking movements that the hands are required to glide; greasy fingers are a decided disadvantage in kneading movements, where it is necessary to grip the muscles.

A lubricant is desirable (*a*) when a limb has been in splints, as it prevents showers of tiny particles of skin from flying about; (*b*) over lately healed wounds; (*c*) when the patient is very emaciated or aged, or very young; (*d*) when the skin of the patient or the hands of the operator are damp.

Under these conditions, pure olive-oil, neat's-foot-oil, cocoa butter, or lanoline cream may be used. Children are sometimes rubbed with a cream made of lanoline and cod-oil.

No medicated oil or ointment should ever be used, except by a doctor's direction. Patients are always grateful to find the masseuse uses neither oil nor powder. The latter is most objectionable, and should never be used.

Inunction is good and useful, especially for young and delicate children, but it is not massage, and they must not be confused.

Quotations from well-known writers on massage will show there is good authority for 'dry rubbing.'

Dr. W. Murrell says: 'I am sure it is a mistake to use lubricants of any kind. Dry rubbing is to be preferred for the following reasons: You get better contraction of muscle and consequently a greater flow of lymph; electrical currents are more readily developed in the tissues; there is a greater elevation of temperature in the part.'[1]

Dr. Stretch Dowse says: 'Some skins are very coarse and naturally greasy, and when this is the case I recommend the part to be well washed with a solution of eau de Cologne and ammonia; I maintain that no form of unguent, fat or vaseline should be used during the massage process, with two exceptions, namely, to the abdomen and to the joints. After massage it is well to anoint these parts with some unctuous material, because it causes the heat and increased activity to be maintained.' In remarking on the anointing of children, he says: 'Apply your massage first; your own skin should come into direct contact with that of your patient; then you may work in cod or any other oil you like. Experience proves that oil rubbed into the skin of young children of a weakly and delicate constitution allays irritability and promotes nutrition.' Dr. Dowse advises equal parts of castor-oil and chloroform to be used to deaden pain in stiff joints, and in his primer for beginners says oil should be used from 'first to last' in abdominal massage.

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[1] 'Massotherapeutics.'

Dr. Douglas Graham, an American writer, says: 'Various greasy substances have been employed, so that ignorant and would-be masseurs may rub without injuring the skin; when the skin is cold and dry, or cold and moist, and the tissues in general are insufficiently nourished, as well as in certain fevers and other morbid conditions, there can be no doubt of the value of inunction; but no special skill is required to do this work, and there is no need of calling it massage. The multitude of modern bruisers and greasers who are supposed to do massage might profit by a hint from Galen as to the best time for applying unctuous material.'[1]

Dr. Benjamin Lee, also an American, writes that 'in long-continued firm work on sprains, lubricants are undoubtedly advisable,' but adds: 'In general massage, where large regions of the body are gone over, this can never be necessary.' Again: 'When we are applying massage in surgical affections, the use of an unguent is appropriate, but when we are treating general or medical disorders, it is not called for; of course the intervention of such an agent would be a frequent obstacle to the stimulation of the surface circulation.'[2]

Dr. Emil Kleen writes that lubricants are 'often necessary, especially where vigorous effleurage is called for, otherwise pain would be caused by traction on the hairs of the skin.'[3]

Dr. Weir Mitchell says that traction of the hairs 'may be avoided by using cocoa-oil or vaseline,' and adds, 'These, however, make the work less efficient and more difficult, and I do not order them unless it is considered desirable to rub in some oleaginous material.'[1]

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[1] Lectures on Massage.

[2] Tracts on Massage.

[3] Handbook on Massage.

Beginners will find it easier at first to work with a lubricant; but when they have learnt how to use their hands, it should be no longer used, except under the circumstances named above.

Traction on hairs may be avoided by omitting effleurage on hairy parts, and using only such movements as move the skin with the hands.

There are four principal terms used in massage; they are:

Effleurage,	**Friction,**
Pétrissage,	**Tapotement.**

Several other terms are used, but all movements may be classified under three heads, thus:

All *stroking* movements under the head of Effleurage.

All *pressure* movements under the head of Pétrissage.

All *percussion* movements under the head of Tapotement.

There is a movement which does not, strictly speaking, belong to any of these; it is *vibration*.

EFFLEURAGE.

This movement may be done with the lightest touch of the tips of the fingers, or with the whole palmar surface of the hand held in different ways, and with various degrees of pressure till it borders on **pétrissage.** Whatever pressure is made should be in the direction of the venous blood and lymph flow; therefore in the limbs it is upwards and from the head downwards. The hand is not lifted at the end of a stroke, but glides back to where it started, without pressure and without losing contact with the patient. The various ways of doing this movement are:

1. The fingers are held straight and close together, but not stiffly. The tips, or cushions, are placed on the part to be worked—for example, the wrist; a straight upward stroke is made with little pressure, the fingers glide back with no pressure, say twenty times. This form of effleurage is useful in the beginning treatment of sprains, in synovitis of the knee or

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[1] 'Fat and Blood.'

any joint, and in neuritis. It may be done firmly at other times in the course of nerves.

2. The cushions of the fingers to be placed in the same way and moved in overlapping circles, lightly and slowly moving on gradually without pressure. This is useful in insomnia, done on the spinal column or on the forehead. It allays irritability in a nerve after more vigorous treatment.

3. A straight stroke with the whole palmar surface of the hand held flat, the return stroke as before, twenty times.

4. The thumb is separated from the fingers and placed across the top of a limb; the fingers are underneath, the limb being, as it were, held in the hand; the strokes are made as before. This is a good way to effleurage the limb of a child; the hand embraces the small limb, and every aspect of it is done at the same time. It is also used on the inner and outer aspects of large limbs.

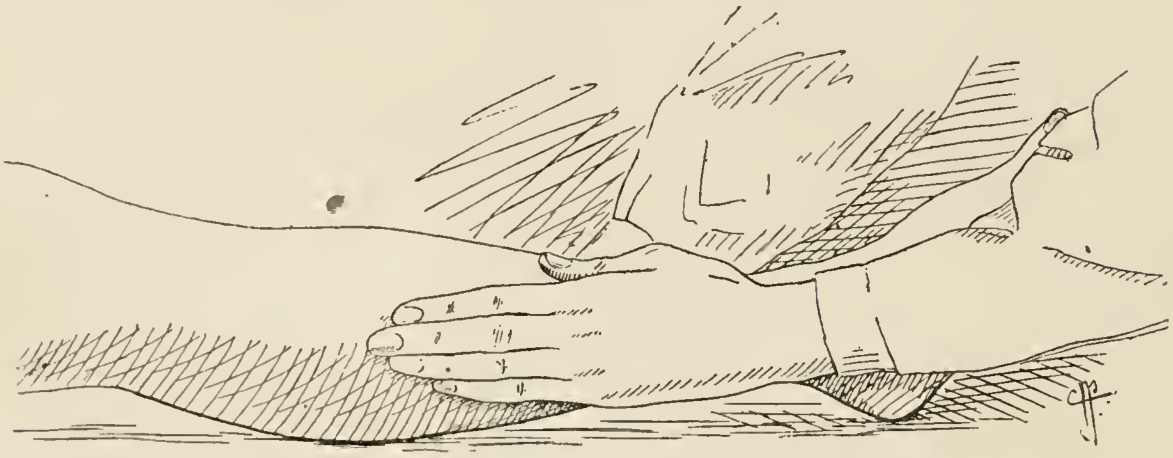

Fig. 1.—Effleurage with Straight Hand.

5. The hands are placed one on each side of a limb, fairly firm pressure is made upwards, both hands acting at the same time; this borders on pétrissage, and is useful in cases of obesity.

6. The thumbs are placed parallel on the top of a limb, the fingers underneath, a sweeping upward movement with each hand alternately is made, gliding back almost to the starting-point, again sweeping upwards and back till the required space is covered.

This is a pleasant and soothing finish after other movements. Except the first two, all these movements are done rapidly. Dr. Douglas Graham gives the number of strokes as

100 to 160 per minute below the knee, and from 60 to 100 above. No. 1 is done slowly because it is used mostly over swollen and tender parts, No. 2 because slow movements are more soothing and more likely to quiet nerves and induce sleep.

Effleurage acts on the skin, superficial fascia, and on the cutaneous vessels and nerves; through the latter impulses are sent to the more deeply seated nerves. It quickens the circulation in the superficial veins, capillaries, and lymphatics, and the arterial circulation is also accelerated by venous pressure being lessened.

PÉTRISSAGE.

This is a deep movement, and done on the muscles, which are grasped between the thumbs and fingers, or in the palms of the hands, and kneaded, rolled, and squeezed in the following manner:

1. With one thumb and index-finger any single muscle, or the muscles of the cheek or palm of the hand are grasped, the finger is kept steady, and the muscle is rolled back on it with the thumb, or the thumb is kept steady and the muscle is rolled back with the finger; this is repeated several times—say five—then a very slight onward movement is made, and the kneading is repeated, and so on.

2. A group of muscles is grasped between the fingers and thumbs of both hands, the fingers being on one side and the thumbs on the other; the thumbs are kept steady, and the muscle is worked back against them with the fingers, or *vice versâ;* repeat on the same spot five times, move slightly onward, and repeat. In this way the movements are continually overlapping, and no portion can be left undone.

3. The muscles to be grasped in the hand between the fingers and heel of hand or ball of thumb, and kneaded by the heel of hand against the fingers.

4. The arms or leg, where there are masses of muscles, is grasped between the hands one on each side, the fingers (Fig. 2) are kept steady, while the thumbs and palms work against them with an upward, outward, and spiral movement, by which the tissues are rolled, squeezed, and kneaded. Every

bit of the hand must be kept in close contact with the flesh, and the progress upward gradual. This movement is the most difficult to describe and to acquire; it is also the deepest and the best.

5. The limb is grasped in both hands, one in advance of the other, very much as a cloth is held when being wrung; the hands are twisted round the limb backwards and forwards, carrying the muscles with them; the movement is called 'wringing,' and is very useful for the limbs of children suffering from **infantile paralysis.** It is a favourite movement with the little ones.

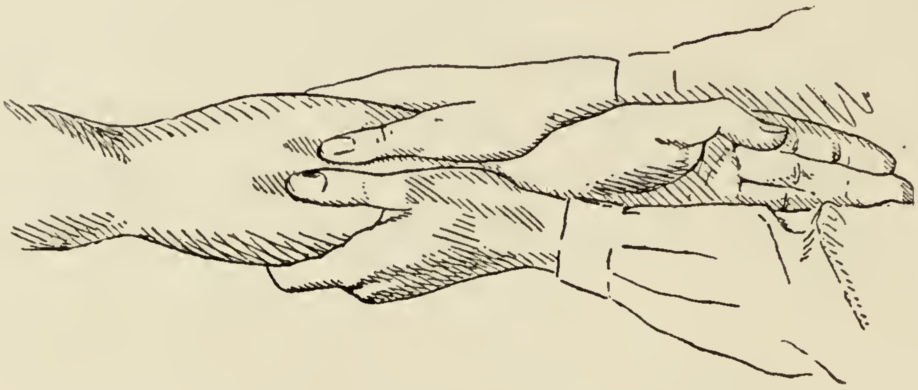

FIG. 2.—PÉTRISSAGE WITH PALMS.

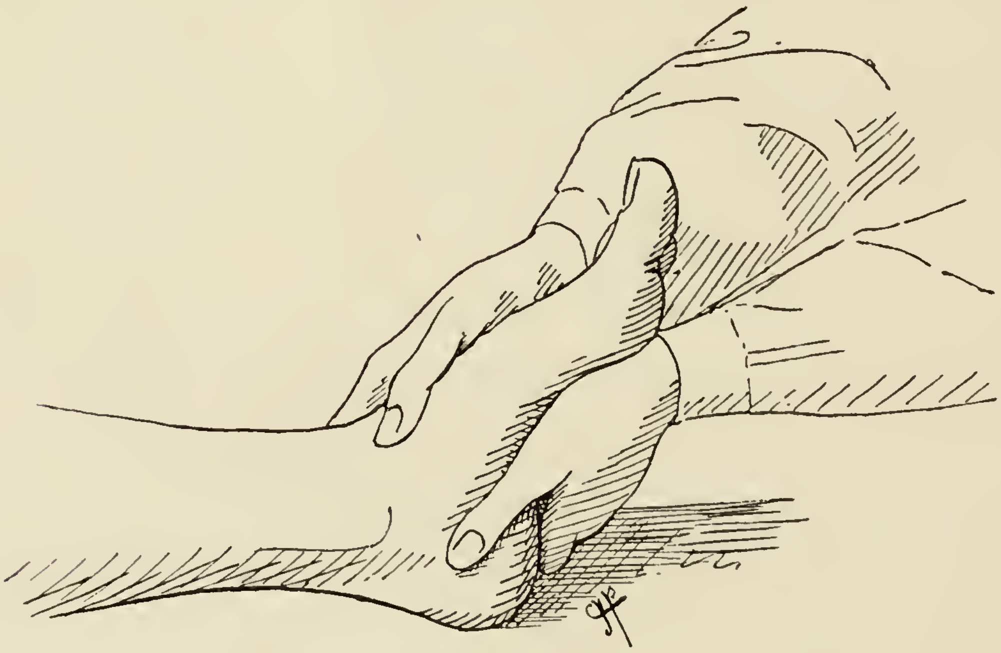

FIG. 3.—PÉTRISSAGE OF SOLE OF FOOT.

6. This movement, which is called **pincement,** differs from the others of this class in that the muscles are not worked on, but only the skin and immediately underlying tissue; these tissues are taken up between the fingers and thumbs, the fingers on one

side, the thumbs on the other, held end to end; the thumbs work alternately in rotatory manner and press and squeeze the tissues against the fingers. It is a useful movement in obesity and œdema. The muscles may also be worked on in this way, especially when wasted; they sometimes seem little more than connective tissue, and in such cases pincement is suitable.

Pétrissage is the most important movement in massage. In it the muscles and other tissues are: (*a*) stretched and lifted from the bone; (*b*) the nerves, bloodvessels and lymph vessels, glands, and all tissues, are stimulated; (*c*) by alternate compression and relaxation lymph is forced out of the spaces and into the lymphatics. By the same compression and relaxation veins are alternately emptied and filled, so that effete matter is sent onward, and a supply of fresh blood favoured. All this cannot be accomplished if the work is not deep. The muscles must be thoroughly gripped and well kneaded; this does not mean that force should be used; it is never necessary. The delicacy of the tissues worked on must be borne in mind, also that these tissues are bathed in lymph and surrounded

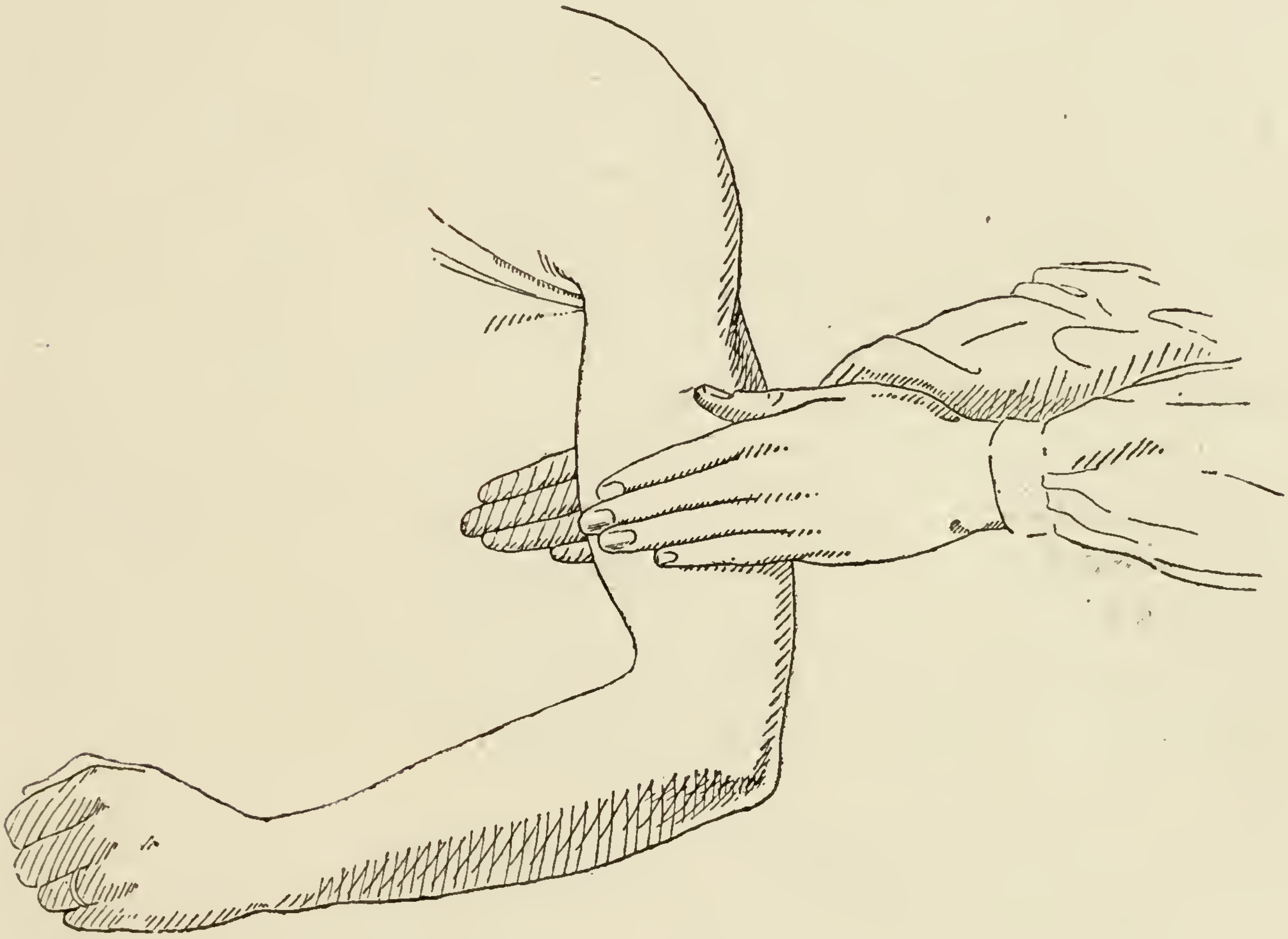

FIG. 4.—FULLING.

by vessels prepared to carry away all that is not wanted by the tissues; intermittent compression without undue force is all that is required to increase the activities of these vessels.

Fulling is a movement which may be classed with effleurage or pétrissage, according to the amount of pressure used; by some it is called 'light friction rolling' (Fig. 4), which places it under effleurage. By others it is described as 'kneading with both hands,' which places it under pétrissage. Its value is certainly enhanced if it is done firmly, the hands carrying the muscles with them. It was named by Ling from the way fullers scour cloth. One hand is placed under a limb, palm upwards; the other over it, palm downwards, and exactly above the first hand. A rapid to and fro movement is made on the limb with both hands, as one does in warming the hands by rubbing the palms against each other. Several movements are made in one place before advancing. The advance is slight and the movement is repeated, thus overlapping the movements as before.

A kneading movement, which has some of the characteristics of both pétrissage and friction, is done in the following manner: The tissues are moved about in large circles by the tips of the fingers of the right hand, which are kept straight by the tips of the fingers of the left hand being placed on the second phalanges. It is called **finger kneading.**

MASSAGE À FRICTION.

Friction differs from pétrissage proper in that the muscles are not raised or drawn away from the bone. It is done with the cushion of the thumb, or of the fingers, or with the palm of the hand. It is always followed by effleurage. The two movements may be done at the same time—friction with one hand while effleurage is done with the other; this is a much more difficult way. It is used chiefly on joints, but is also very useful where tissues are matted and thickened.

The cushion of the thumb is placed on the skin and kept on one spot; by describing small circles with it, without moving it on the skin, the tissues underneath are worked on each other. When several circles (five to ten) have been made, the thumb is moved on, and the action is repeated. Effleurage is immediately done over the same region, then friction again, followed by effleurage. The tips of the fingers and the palm of the hand are used when more appropriate. The effect of this movement is to squeeze out and move on the products of inflammation, to further absorption, and stimulate local circulation.

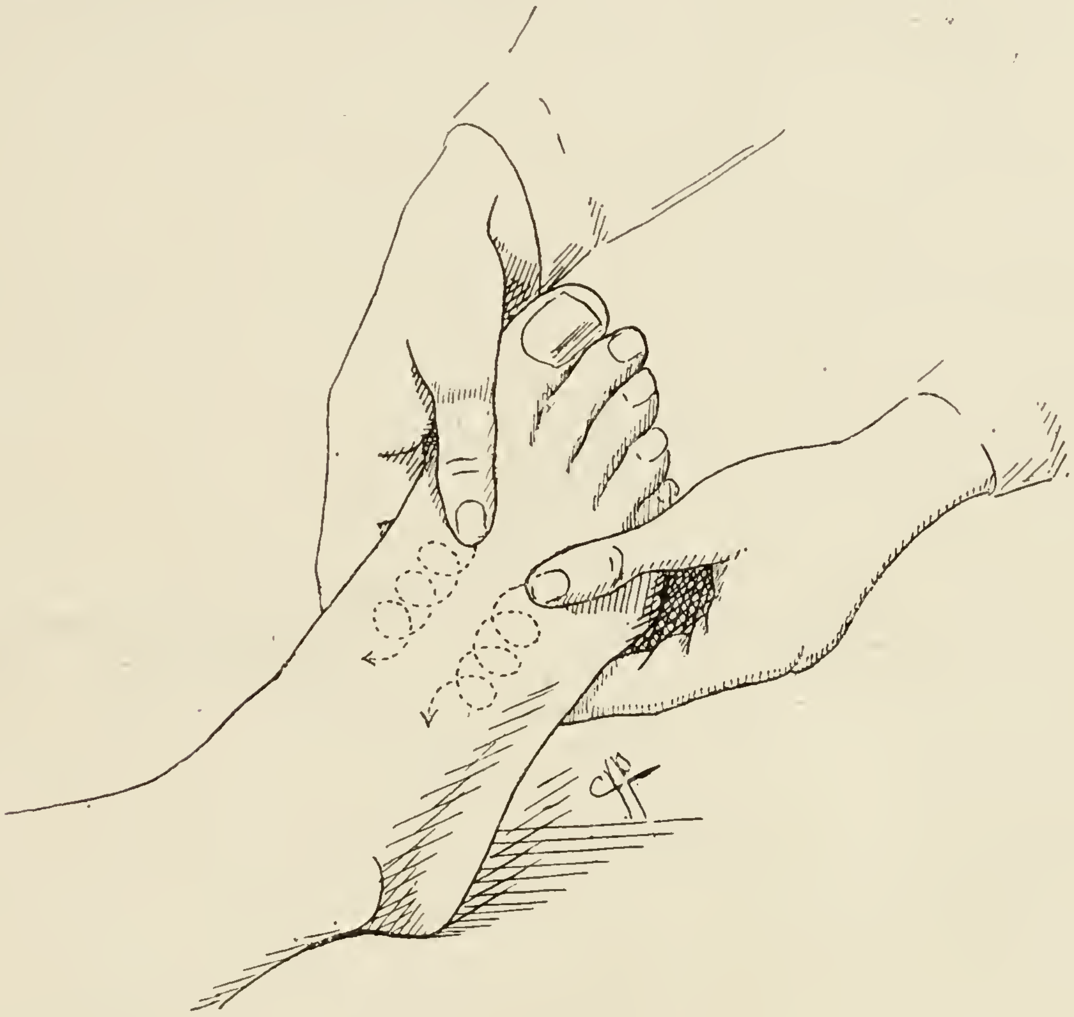

FIG. 5.—FRICTION.

TAPOTEMENT.

In doing tapotement, the hands must not be raised more than an inch from the patient's body. The movements should be light, sharp, and springy, the hands swinging from the wrist. It is performed rapidly, and in various ways.

1. **Slapping.**—The palmar surface of the fingers, held straight and close together, strike the muscles transversely, evenly, and rhythmically, moving backward and forward and in every direction, leaving no part untouched.

2. **The Flail.**—The back of the semi-flexed fingers, held

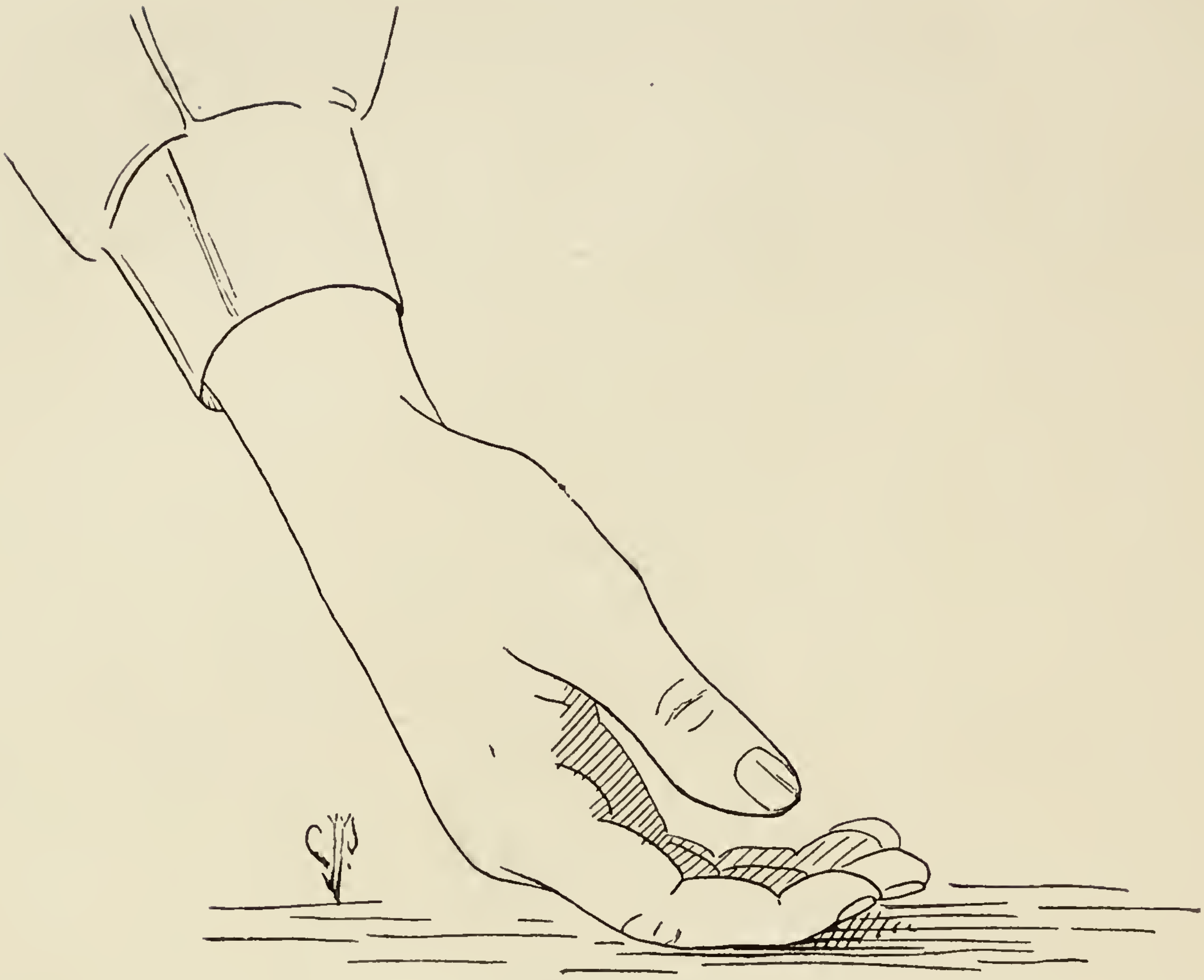

Fig. 6.—The Flail.

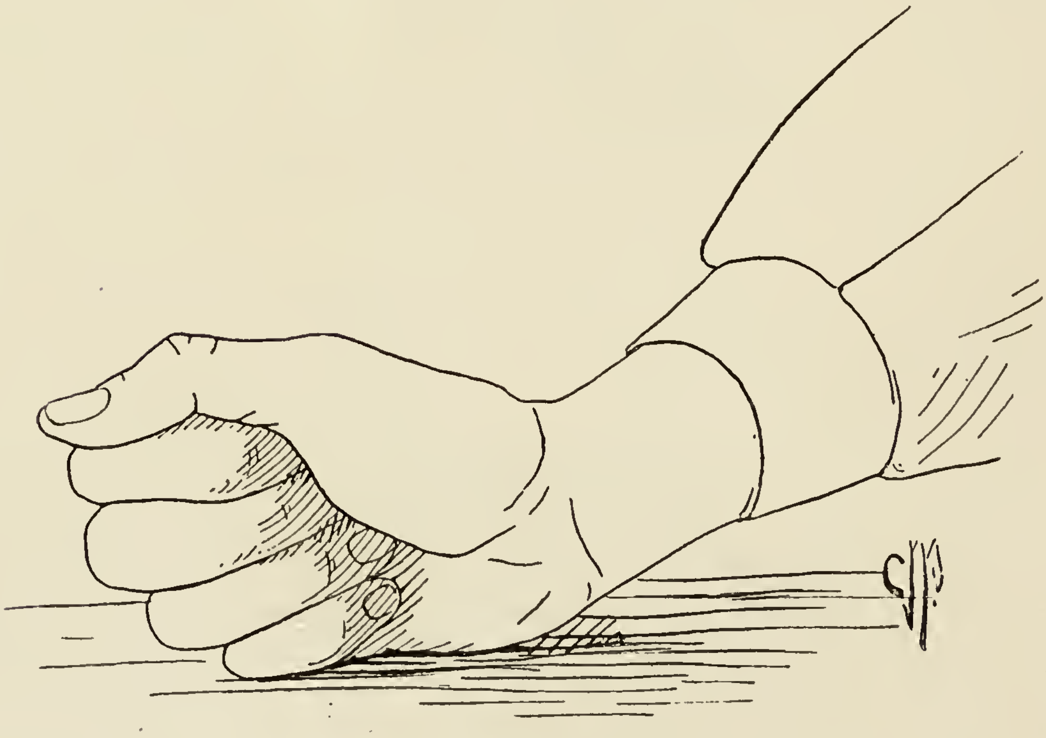

Fig. 7.—Beating.

loose and open, to strike as in the previous movement. These two movements are suitable for the forearms, legs, and back.

3. **Tapping** is done with the tips of the open fingers, or with the tips brought together so as to form a cone. In the first form one or all of the finger-tips are used. It is suitable on the head and chest. In the second form it is used on the thighs, over masses of muscles.

4. **Beating** is done with the ulnar border of the closed hand, or hands, working alternately, used on thighs and buttocks.

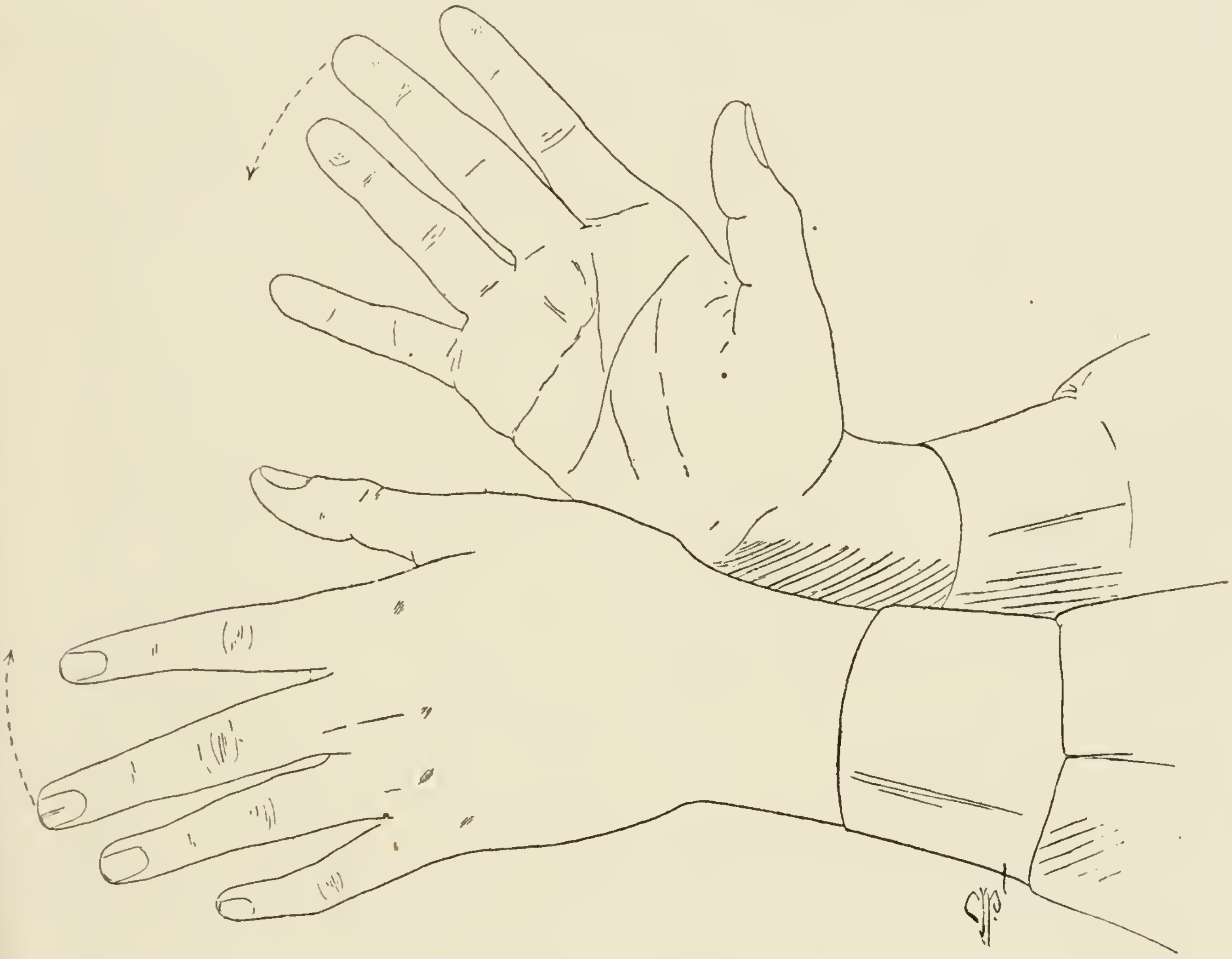

FIG. 8.—HACKING.

5. **Chopping or Hacking.**—The ulnar borders of the open hands and fingers are used; the hands are held a little apart, palm towards palm. The fingers, separated and held loosely, fall together at each blow; the hands strike alternately. This is a deservedly favourite movement. It is used on the back and over nerve trunks. In striking, the little and third fingers come down.

6. **Clapping** is done with the whole palmar surface of the

hands striking alternately; the palms are contracted so as to form a hollow or cup. It is used on the thighs and back.

Tapotement excites capillary circulation, stimulates nerves, and causes muscle contractions.

VIBRATIONS.

The fingers or hands are placed on some part of the patient's body, and a trembling sensation conveyed to it by them.

1. The fingers, drawn together at the tips, are placed on a nerve; the arm and hand of the operator are made to tremble, and thus convey vibrations to the nerve.

2. The palmar surface of one or both hands is laid on the abdomen (over the intestines or over the liver); the arm is held straight, and the same sensation conveyed to the patient through the trembling of the hand.

3. Another way is to draw the fingers rapidly, one after the other, beginning with the little finger, across a nerve; the course of the nerve can be followed in this way.

In 1 and 2 the fingers, or hands, must not be allowed to move on the skin.

Vibrations are also conveyed to a nerve by hacking over it. Prolonged hacking, or any percussion, causes a nerve to become numb. There is a movement which partakes of the character of a vibration and of pétrissage. The fingers and thumb are extended, and a mass of muscle grasped, which is raised from the bone. It is held for a moment or two while a trembling movement is given to the hand; the muscle is then dropped. It is a deep, vigorous, and stimulating movement.

It is desirable that massage should be applied directly to the skin, but it can be given over a garment. Some patients prefer that it should be.

CHAPTER II

THE HUMAN BODY

Physiology is the science which treats of the uses of the various parts of the body.

Anatomy is the science which treats of the structure of the various parts of the body.

The organs and other parts of the human body are composed of *tissues*, the chief of which are: (1) Bony or osseous tissue, (2) muscular or contractile tissue, (3) nervous or conductile tissue, (4) fibrous or connective tissue. These tissues are formed by a collection of *cells*. A cell is a soft, jelly-like substance called protoplasm (living matter), the chemical constituents of which are three gases—**hydrogen, nitrogen, oxygen**—combined with three solids—**carbon, sulphur**, and **phosphorus.**

Each organ of the body is adapted to fulfil some special function ; for instance, the eye is the organ of sight, the stomach an organ of digestion, and so on.

All the tissues are built up and nourished by the blood.

The bony tissue forms

THE SKELETON.

There are over 200 bones in the human skeleton, which form a strong framework of hard, tough material, which protects internal soft parts, supports the limbs and trunk, and gives attachment to muscles. The hardness of bone is due to calcareous or earthy matter, and the toughness to an animal substance resembling cartilage. Bones are of different shapes ; there are *long*, *short*, *flat*, and *irregular* bones. The two first are in the limbs ; the two last, with the exception of the patella and scapula, are in the trunk and head. The bones of the

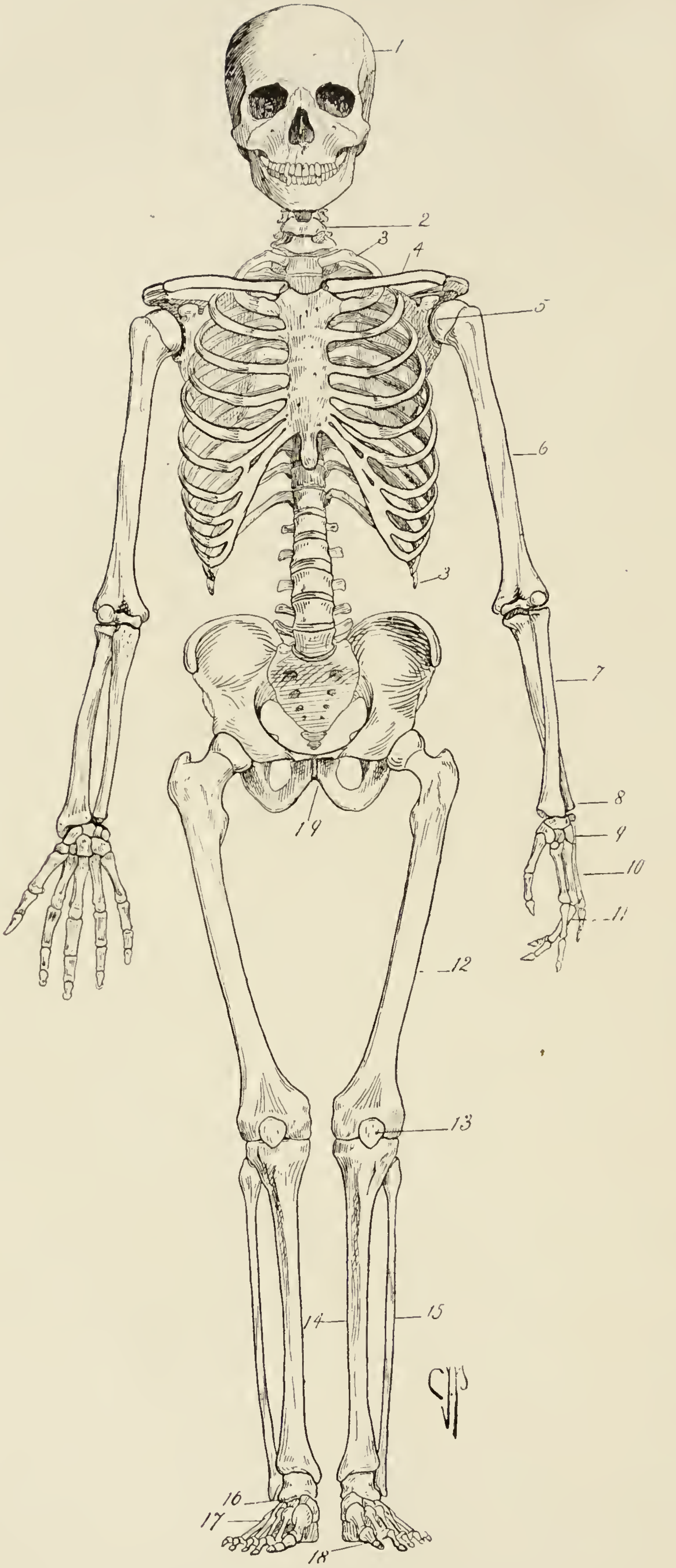

FIG. 9.—SKELETON, FRONT VIEW.

1, Cranium; 2, cervical vertebræ; 3 to 3, ribs; 4, clavicle; 5, scapula; 6, humerus; 7, radius; 8, ulna; 9, bones of carpus; 10, bones of metacarpus; 11, phalanges; 12, femur; 13, patella; 14, tibia; 15, fibula; 16, bones of tarsus; 17, bones of metatarsus; 18, phalanges; 19, pubes.

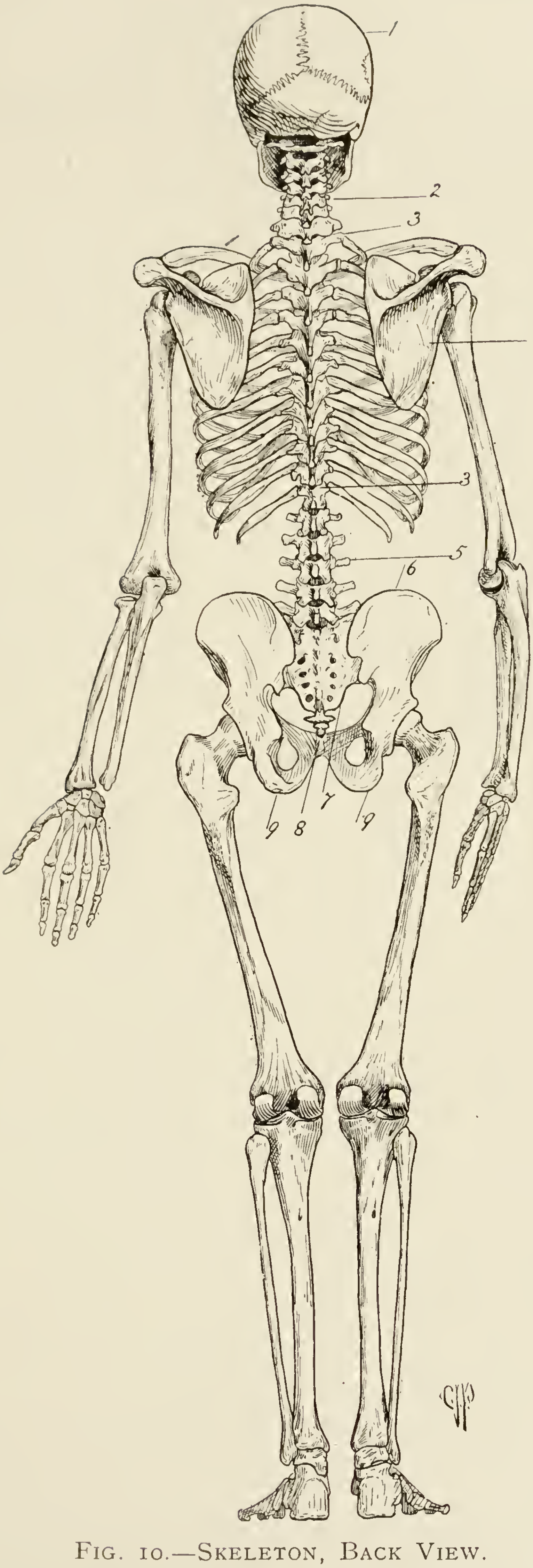

Fig. 10.—Skeleton, Back View.

, Cranium ; 2, cervical vertebræ ; 3 to 3, dorsal vertebræ ; 4, scapula ; 5, lumbar vertebræ ; 6, ilium ; 7, sacrum ; 8, coccyx : 9, ischium.

head and trunk form cavities for and protect the organs contained in them.

The *long* bones consist of two ends and a shaft; in the shaft there are two forms of bony tissue, a compact, and a spongy. The compact is on the surface, and the spongy within it; there is a canal in the centre called the **medullary canal**, which contains marrow. There are openings in the compact bone for bloodvessels, lymphatics, and nerves, which are called **Haversian canals**, from **Havers**, who discovered them. The fibrous membrane covering bone is called periosteum; small vessels from it pierce the bone underneath and supply it with blood. The ends of bone consist mainly of spongy or cancellated bony tissue covered by cartilage. The *marrow* in the ends of long bones and in all short and flat bones is red; it contains many bloodvessels and little fat. In the shafts of long bones the marrow is yellow; it consists chiefly of fat, and has also bloodvessels.

Table of Bones.

HEAD.

CRANIUM (8):
- Occipital (1).
- Parietal (2).
- Temporal (2).
- Frontal (1).
- Ethmoid (1).
- Sphenoid (1).

FACE (14):
- Nasal (2).
- Lachrymal (2).
- Malar (2).
- Superior maxillary (2).
- Inferior maxillary (1).
- Palate (2).
- Inferior turbinated (2).
- Vomer (1).

NECK (8).

- Cervical vertebræ (7).
- Hyoid bone (base of tongue).

TRUNK.

THORAX (37):
- Dorsal vertebræ (12).
- True ribs (14).
- False (6).
- Floating (4).
- Sternum (breast-bone).

LUMBAR REGION (5):
- Lumbar vertebræ (5).

PELVIS (4):
- Innominata (2).
- Sacrum.
- Coccyx.

Upper Limb (32):
- Clavicle.
- Scapula.
- Humerus.
- Ulna.
- Radius.
- Carpus, or wrist:
  - Scaphoid.
  - Semilunar.
  - Cuneiform.
  - Pisiform.
  - Trapezius.
  - Trapezoid.
  - Os magnum.
  - Unciform.
- Metacarpal (5).
- Phalanges (14).

Lower Limb (30):
- Femur.
- Patella.
- Tibia.
- Fibula.
- Tarsus, or ankle:
  - Os calcis.
  - Astragalus.
  - Cuboid.
  - Scaphoid.
  - Internal cuneiform.
  - Middle cuneiform.
  - External cuneiform.
- Metatarsal (5).
- Phalanges (14).

In the fingers, toes, and soles of the feet there are small bones like peas, called sesamoid bones, from their resemblance to the seed of the sesamum; they are formed in the substance of tendons; they prevent friction and increase power. The patella is a large sesamoid bone developed in the tendons of the quadriceps extensor muscles.

JOINTS.

Joints are distinguished as **movable** and **immovable**; wherever two or more bones of the skeleton meet a joint is formed. Movable joints are those in which the bones forming them move on each other; they are divided into **perfect** and **imperfect**. There are four kinds of perfect joints:

1. **Gliding** joints, consisting of bones which glide on each other, as the wrist.

2. **Ball and socket joints**, consisting of a round head, which rotates in a socket, as the shoulder joint.

3. **Hinge joints**, capable of only backward and forward movement, as the elbow.

4. **Pivot joints**, where one bone rotates round a projection of another bone, as the radius on the humerus.

In each of these joints the surfaces which move on each other, called articulating surfaces, are covered with a layer of cartilage, which is again covered with a membrane called synovial membrane; it forms a closed sack, called the synovial cavity, which contains synovia, a fluid resembling white of egg, which serves to keep the joints moist.

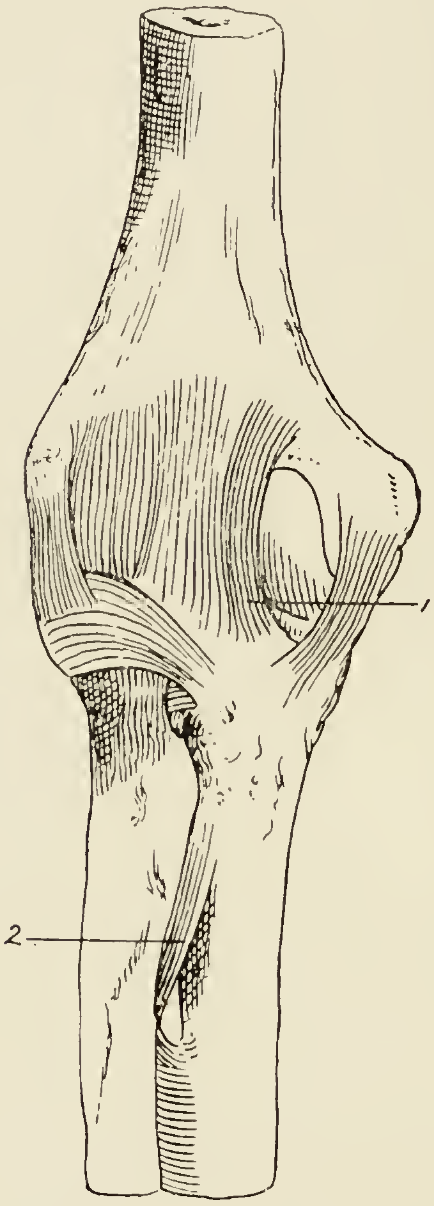

Fig. 11.—Ligaments of Elbow.

1, Capsular; 2, interosseous membrane.

An **imperfect** joint is one in which a plate of cartilage intervenes between the bones, and the movement in the joint is due solely to the flexibility of the layer of cartilage; the vertebræ form such joints.

Immovable joints are those in which the bones are in contact without any cartilage between; each bone has teeth-like edges which dovetail, as in the skull.

CARTILAGE.

Cartilage is very well known under the name of 'gristle'; it is a tough, flexible, elastic substance found in every part of the body; it has neither bloodvessels nor nerves.

Temporary cartilage is found in the skeleton of young subjects; it is afterwards replaced by bone.

Permanent cartilage is of three varieties—hyaline, white fibro-, and yellow fibro-cartilage.

True or hyaline cartilage covers the ends of bones, where it is called *articular* cartilage; it joins the ribs to the sternum, forming the *costal* cartilages; it also enters into the formation of the nose, ear and throat.

In some parts of the body the connective tissue is more or less mixed with cartilage, and such tissues are called **fibro-cartilage.** White fibro-cartilage very much resembles white fibrous tissue. **White fibro**-cartilage is found in the discs between the vertebræ, in the glenoid and cotyloid ligaments, in the semi-lunar cartilages, sacro-iliac joint, symphysis pubis, and other articulations.

Yellow or elastic fibro-cartilage is found in the epiglottis, the outer ear, and the Eustachian tube. It is tougher and more flexible than hyaline cartilage.

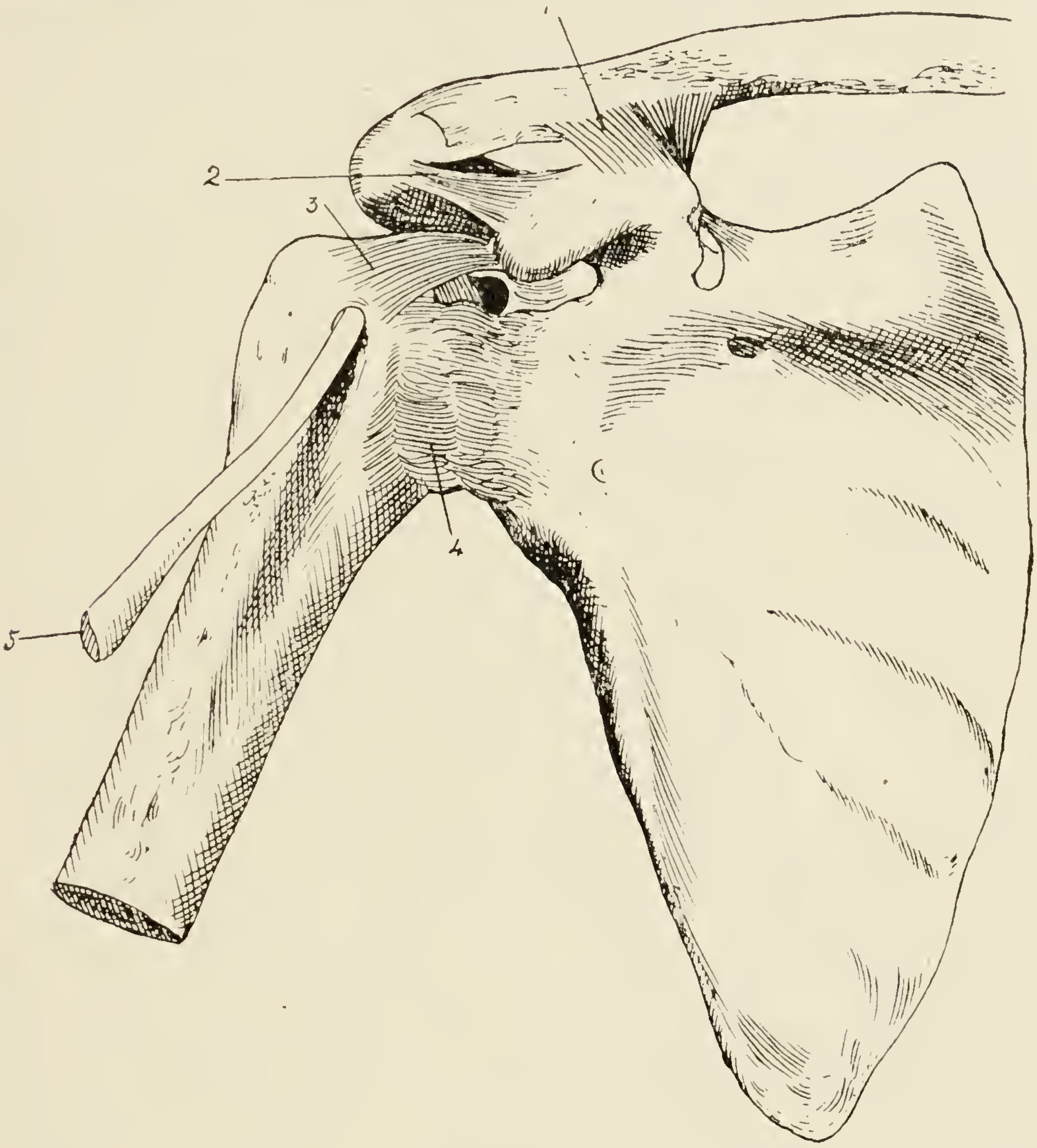

FIG. 12.—LIGAMENTS OF SHOULDER.
1, Coraco-clavicular; 2, coraco-acromial; 3, coraco-humeral; 4, capsular; 5, tendon of biceps.

Cartilage has very wide uses.

It forms smooth surfaces and lessens friction, as in joints.

It breaks shocks, acting as a buffer, as in the spine.

It gives elasticity, as in the walls of the chest.

It deepens cavities, as in the hip and shoulder joints.

It forms a firm framework, as in the larynx, outer ear and nose.

Articular cartilage depends for nutriment on the blood-vessels of subjacent bones and synovial membrane; other cartilages are covered by a vascular fibrous membrane, called **perichondrium**, and receive nourishment from it.

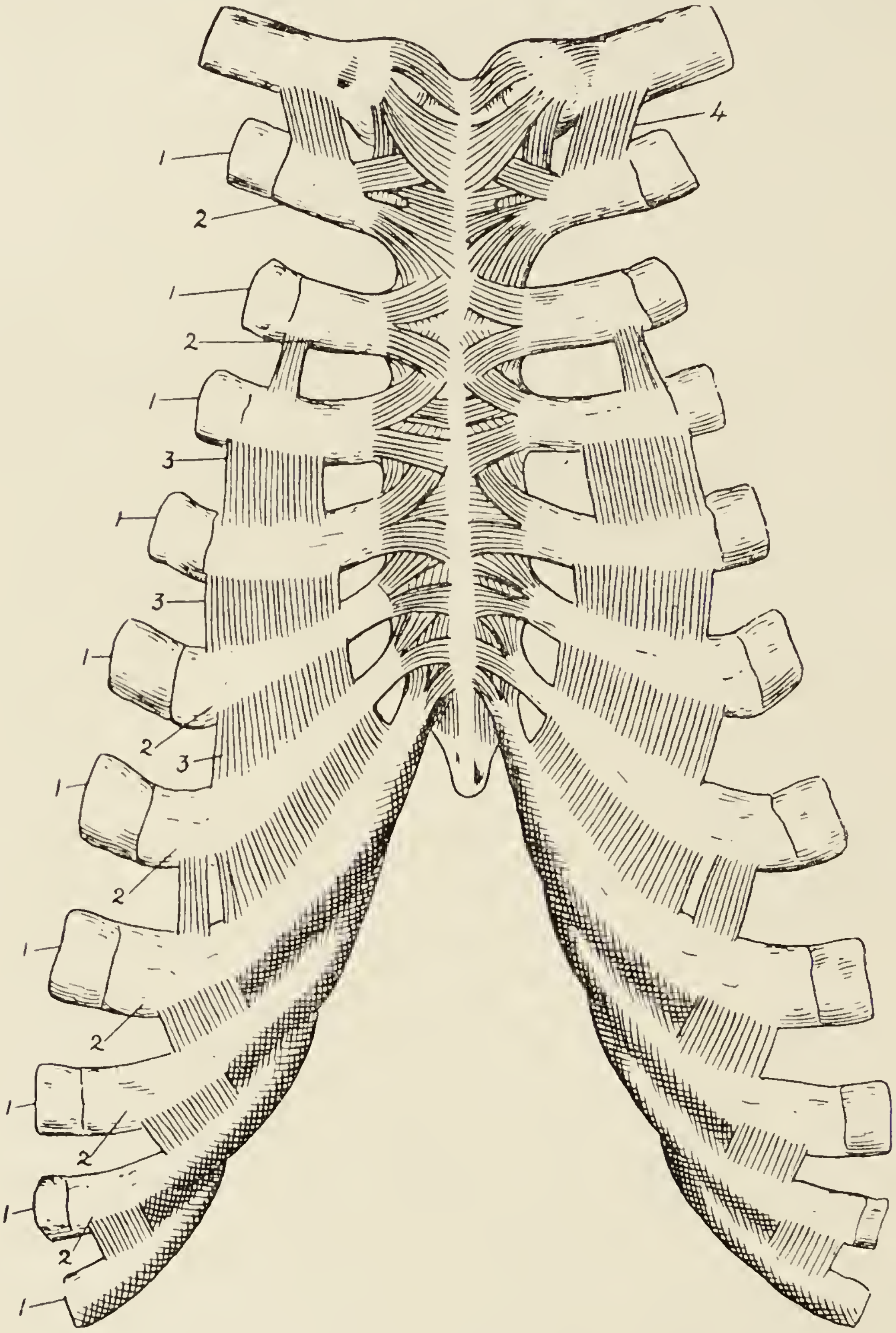

FIG 13.—LIGAMENTS OF RIBS AND STERNUM.
1, Ends of ribs; 2, cartilages; 3, ligaments joining cartilage: 4, ligament uniting clavicle and first rib.

SYNOVIAL MEMBRANE.

Synovial membrane is composed of a form of connective tissue, and secretes a glairy fluid resembling the white of egg, named **synovia**. It lines joints, which are lubricated by the fluid, and motion is thus facilitated. It also forms sheaths for some tendons. **Bursæ** are sacs of synovial membrane interposed between two surfaces which move on each other; deep-seated bursæ are placed between muscle and bone, or tendon and bone; superficial bursæ are between the skin and some firm prominence under it. There are several bursæ about the knee joint; they are also found on the ankle, elbow, and other joints.

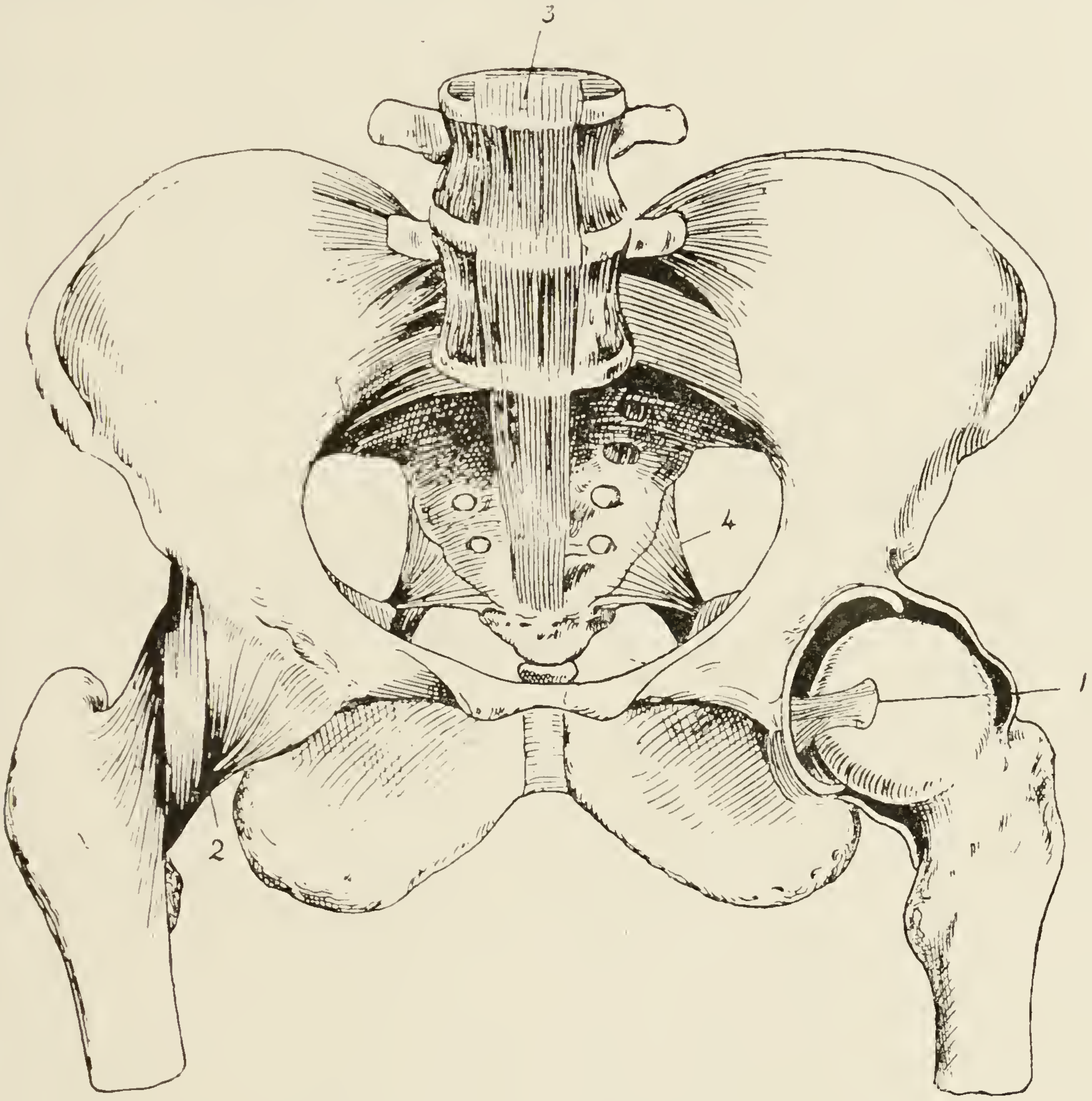

Fig. 14.—Ligaments of Pelvis.

1, Ligamentum teres; 2, capsular; 3, anterior common ligament; 4, great sacro-sciatic ligament.

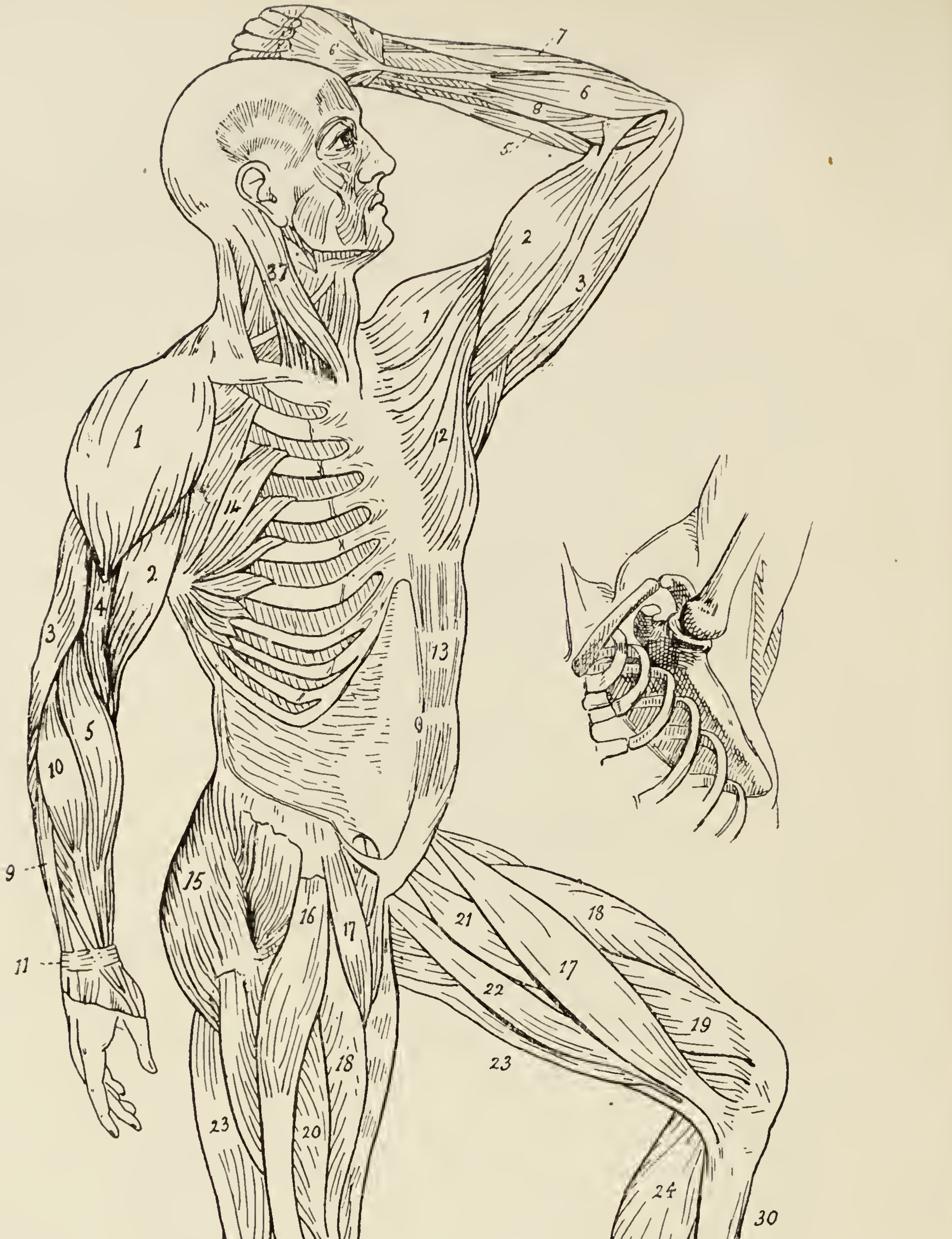

Fig. 15.—Muscles—front and side view.

1, Deltoid ; 2, biceps ; 3, triceps ; 4, brachialis anticus ; 5, supinator radii longus ; 6, palmaris longus ; 6′, insertion into palmar fascia ; 7, flexor carpi ulnaris ; 8, flexor carpi radialis ; 9, extensor communis digitorum ; 10, extensor carpi radialis longus ; 11, annular ligament ; 12, pectoralis major ; 13, rectus abdominis ; 14, serratus magnus ; 15, gluteus maximus ; 16, tensor fascia femoris ; 17, sartorius ; 18, rectus femoris ; 19, vastus internus ; 20, vastus externus ; 21, adductor longus ; 22, gracilis ; 23, biceps ; 24, gastrocnemeus ; 25, peroneus tertius ; 26, extensor digitorum ; 27, tendo Achillis ; 28, soleus ; 29, abductor pollices : 30, tibialis anticus ; 30a, tendon of insertion ; 37, sterno-mastoid.

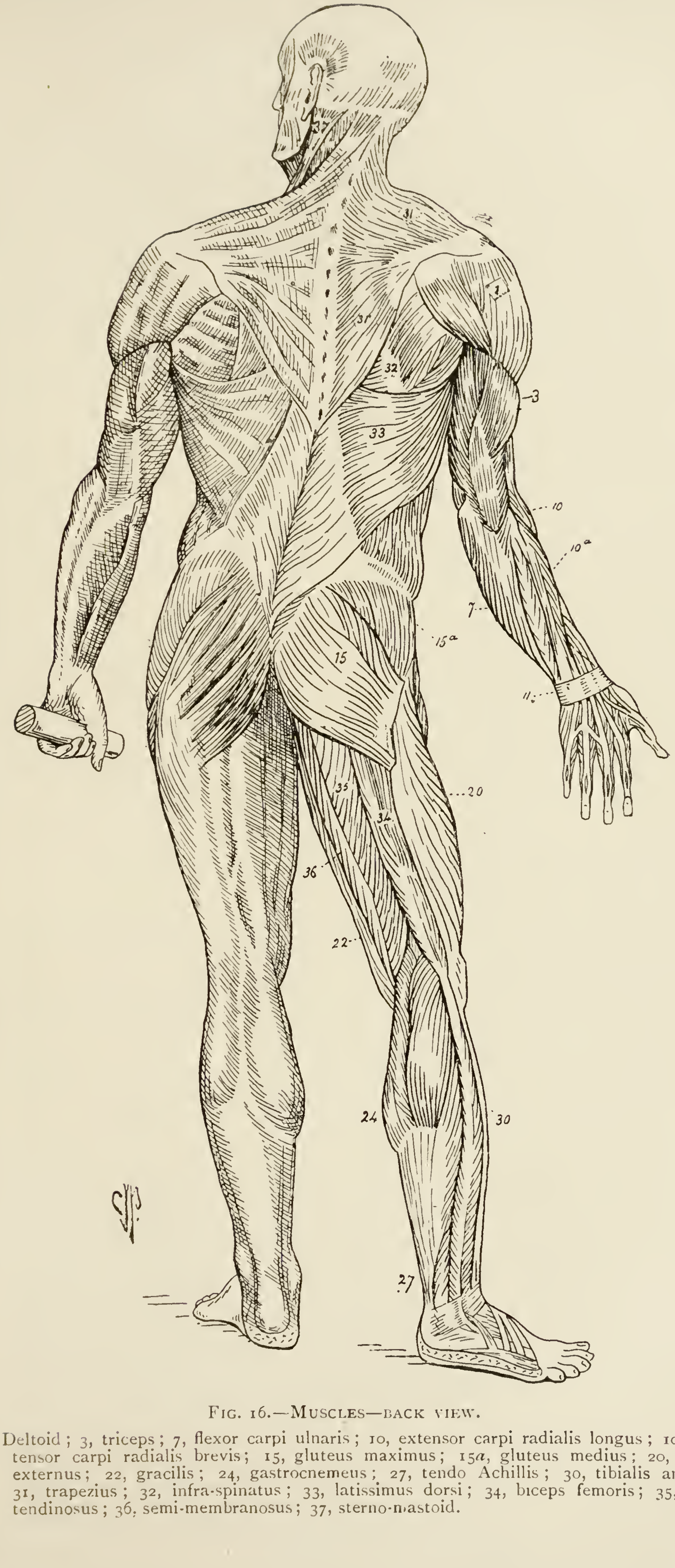

FIG. 16.—MUSCLES—BACK VIEW.

1, Deltoid; 3, triceps; 7, flexor carpi ulnaris; 10, extensor carpi radialis longus; 10*a*, extensor carpi radialis brevis; 15, gluteus maximus; 15*a*, gluteus medius; 20, vastus externus; 22, gracilis; 24, gastrocnemeus; 27, tendo Achillis; 30, tibialis anticus; 31, trapezius; 32, infra-spinatus; 33, latissimus dorsi; 34, biceps femoris; 35, semitendinosus; 36, semi-membranosus; 37, sterno-mastoid.

LIGAMENTS.

Ligaments are bands of strong white fibrous connective tissue which bind bone to bone, and serve to hold them together, while they permit free movement of the joints. The bones are also kept in position by surrounding muscles, and in some cases by atmospheric pressure.

MUSCULAR TISSUE.

The fleshy covering of the skeleton is called muscle, and by means of it the bones are moved. There are two kinds of muscle—**voluntary** and **involuntary**; voluntary muscle is called **striped**, or **striated**, and involuntary muscle **unstriped** or **non-striated.**

Voluntary muscle is composed of bundles of fibres, which are composed of smaller bundles called fasciculi, and these again are composed of still smaller fibres called **fibrillæ.** These consist of little disc-shaped bodies united in such a way as to produce transverse markings, from which the muscle is called **striped**, or **striated**; every fibre is enclosed in a sheath of connective tissue called **sarcolemma.** Numbers of these bundles of fibres, arranged side by side, and bound together by connective tissue, form a muscle.

Voluntary muscles are on the outside of the skeleton, and are under the control of the will.

Involuntary muscle is made up of bundles of fibres, which are composed of elongated cells, generally pointed at the ends. They have no sarcolemma.

Involuntary muscles produce movements over which we have no control, such as the motions of the stomach.

The muscle fibre of the heart differs from those of other involuntary muscles in being striated like those of voluntary muscles. Most voluntary muscles are attached to bones by tendons which are strong, white, shiny, inelastic bands, the continuation of the interstitial connective tissue in which the muscular fibres terminate. Some muscles have fleshy attachments to bones, and some are attached to ligaments, aponeurosis, cartilage, or skin. The attachments are called **origin** and

insertion; the **origin** is the end which is attached to the more fixed of two bones, the **insertion** is the end which is attached to the more movable bone; the thick, fleshy part between is known as the body of the muscle.

Muscles act by contraction; when a muscle contracts it broadens and shortens, and consequently approximates the two ends, thus bringing the more movable bone to the more fixed one; this bone is then brought back to its former position by the contraction of another muscle on its opposite side, which is antagonistic to the first, muscles being generally arranged so that each one has an antagonist. The arm gives a simple example of this. When the muscle on the front of the arm (biceps) contracts the forearm is drawn up, when the muscle on the back of the arm contracts the forearm is straightened. The muscles which bend the limbs are called **flexors**, those which straighten them **extensors**. This power of

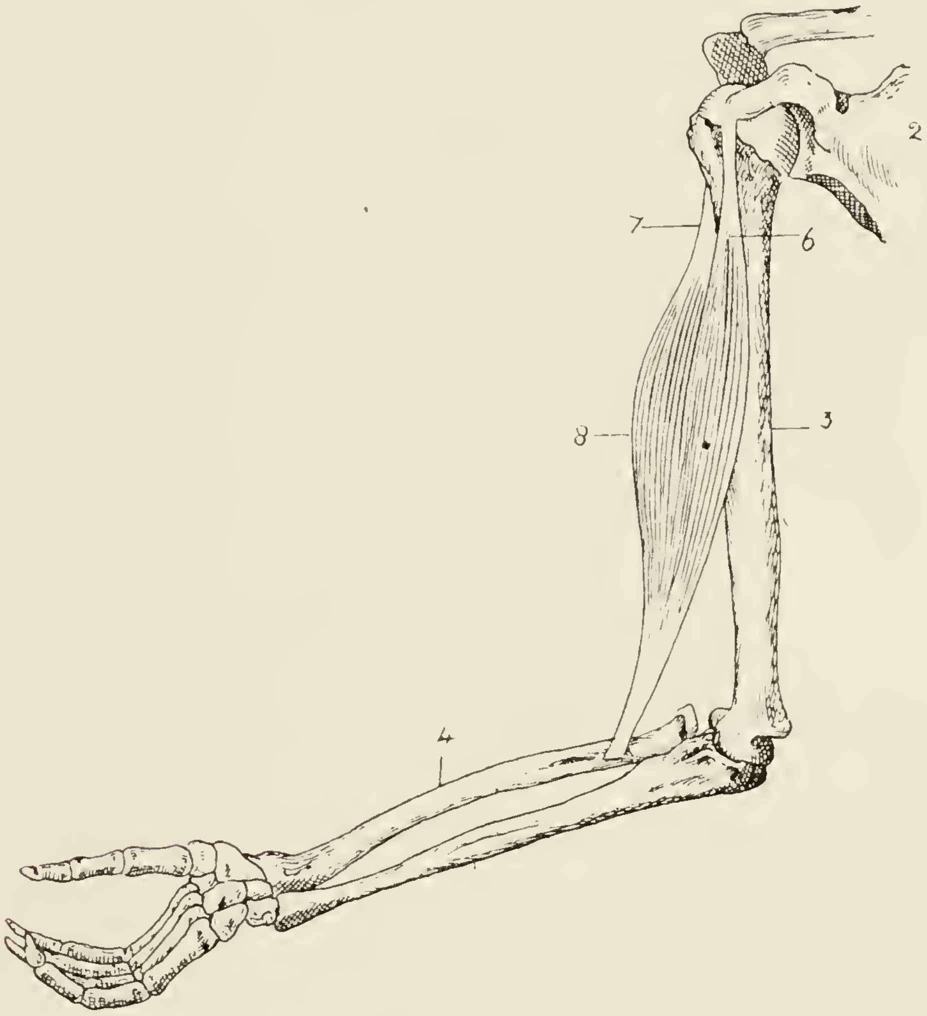

Fig. 17.—Showing Action of Biceps.

1, Clavicle; 2, scapula; 3, humerus; 4, radius; 5, ulna; 6, short head of biceps; 7, long head of biceps; 8, body of biceps.

contraction in muscles must be borne in mind, as when from weakness or wasting it is lost, massage is one of the agents used for restoring it. Muscles are plentifully supplied with nerves, bloodvessels and lymphatics; they form about half the weight of the body. There are over 300 voluntary muscles. Seventy-five per cent. of muscle consists of water.

CONNECTIVE TISSUE.

Connective tissue, also called areolar, fibrous and elastic tissue, is the most widely diffused of all the tissues of the body; besides enveloping all the muscles, it forms a sheath for each. It also forms partitions between muscles, thus separating as well as connecting them; it also encloses vessels and nerves, and covers bones and cartilage. It is a membrane formed of cells, with a great deal of substance between them. It is the difference in this intercellular substance which gives the varieties of tissue.

Areolar tissue invests the muscles, nerves, bloodvessels, and other parts, and is continuous throughout the body; it forms a layer immediately under the skin, and also under the membrane that lines the internal cavities. It consists of two forms of fibres mixed in varying proportions, white and yellow; these fibres cross each other in every direction, having open spaces between them, hence the name; the cells lie in the spaces. In some parts **areolar** tissue is of loose texture, and in others it is close, thus providing for the requirements of the parts it encloses.

White fibrous tissue is found almost entirely in ligaments and tendons and the covering of bones and cartilage. In the form of a membrane it binds down muscles, and takes the name of **fascia** and **aponeurosis**; its structure is much the same as that of areolar tissue, but the fibres adhere more closely, and generally run in one direction instead of interlacing. It is white and shining, strong, tough, pliable, and extensile.

Yellow elastic tissue is not so strong, but it is elastic; it is found in the walls of bloodvessels and air-tubes, and unites the cartilages of the larynx. The ligamentum subflava, which forms bands between some of the vertebræ, is composed of this tissue. It differs in structure from the others in having a preponderance of elastic fibres.

The **subcutaneous** connective tissue is called *superficial fascia;* as well as having fat deposits, it is ramified by cutaneous vessels and nerves before they enter the skin. Beneath this there is another layer of fibrous tissue, which closely invests the muscles, called *deep fascia.*

Adipose tissue comes under the head of connective tissue, because it is in the subcutaneous connective tissue the fat cells are scattered. Fat collects in some parts of the body more than in others; it fills up spaces and gives roundness to the figure; as it is a bad conductor of heat, it serves to keep the body warm.

NERVE TISSUE.

Nerve tissue is composed of cells and fibres enclosed by connective tissue and supplied with bloodvessels and lymphatics; it controls all the other tissues, it is not contractile, but generates and propagates various impulses. The fibres and cells are arranged in masses called '**Nerve Centres,**' or in cords called **nerves.** The former contain fibres and cells; they generate, receive and transmit nervous impulses; the latter are composed wholly of fibres which only transmit impulses. They have been likened to a galvanic battery; the battery, like the nerve centres, generates, receives and transmits the electric current, while the wires, like the nerves, only conduct to and from the battery. They consist of small bundles of fibres called **funiculi**, bound together by a delicate sheath of membrane **neurilemma**; these small bundles are again bound into large ones called **fasciculi**, the whole nerve being at last enclosed in a common sheath of connective tissue. **Cellular** tissue, owing to its colour, is called gray substance.

Fibrous nerve tissue is **gray and white.**

SKIN.

The whole body is covered and protected by skin. It consists of two layers, the **epidermis, or scarf skin,** and the **dermis,**

or true skin. The former is composed of layers of cells which are being continually worn away in the form of powder, and as continually replaced; it contains no bloodvessels and few nerves; it is full of little holes or pores, which are the openings of the sweat-ducts.

The **dermis, or true skin,** consists of fibres of connective and elastic tissue, interlaced with bloodvessels and nerves. The surface has numerous minute elevations called **papillæ.** The sensibility of the skin as the organ of touch is due to the nerve-endings in these elevations; they also contain bloodvessels. Many of the papillæ have small bodies called **touch corpuscles**; they are most numerous in the tips of fingers and palms of the hand. Each papilla is the rudiment of a hair. The deep portion of the dermis is looser in texture and contains some fatty tissue.

The dermis contains two secreting organs, the sweat or **sudoriferous glands—fat or sebaceous glands.**

The sweat glands consist of a coiled tube and a duct which is twisted like a corkscrew in passing through the epidermis. Perspiration is being continually secreted and carried off in invisible vapour; when more is poured out than can at once be removed by evaporation, it appears as drops on the skin.

The sebaceous glands secrete an oily substance called *sebum*; the ducts open into hair follicles, into which the oil is discharged; it also exudes over the whole surface of the skin and keeps it soft.

The *nails* are composed of cells of the epidermis joined so as to form a solid plate.

The *hairs* are growths of the epidermis developed in little pits or follicles. The hair follicles extend down to and below the dermis. The hair grows from the bottom of the follicle; connected with each follicle are small muscles; when these muscles contract the little hairs are pulled straight and are said to 'stand on end.' 'Goose skin' is produced in the same way.

The skin as an excretory organ is nearly related to the kidneys; when free action of the skin is interrupted, its work is usually taken up by the kidneys; both excrete organic and saline matter in solution.

The skin absorbs oxygen and exhales carbonic acid and water as the lungs do.

MUCOUS MEMBRANE.

At all the apertures of the body the skin is directly continued into the mucous membrane, which lines all the cavities into which the apertures open. It consists of a deep layer of connective tissue and a superficial layer called the **epithelium**.

CHAPTER III

THE VASCULAR SYSTEM

The organs of circulation are the

1. **Heart.**
2. **Arteries.**
3. **Veins.**
4. **Capillaries.**
5. **Lymphatics.**

The **heart** lies in the thorax between the lungs, rather to the left side; it is a hollow muscular organ, and by its contractions the blood is forced through all the bloodvessels of the body.

The **blood** consists of a colourless watery fluid (plasma or liquor sanguinis), containing minute bodies called **corpuscles**; they are of two kinds—red and white, the red being by far the more numerous. The colour of the blood is due to a substance in the red corpuscle called hæmoglobin, which has the power of combining with oxygen; this substance contains iron oxide in small proportions.

The heart is divided longitudinally into two halves—right and left; there is no communication between these; the right contains venous or impure blood, the left arterial or pure blood.

Each half is also divided transversely, thus making four chambers; the upper are called **auricles**, the lower **ventricles**. These chambers communicate with each other by the **auriculo-ventricular** orifices, which are supplied with valves to prevent the return of the blood passing from the auricles to the ventricles; the valve in the right side consists of three flaps, and is called the **tricuspid valve**; the valve in the left side has two flaps—it is the **bicuspid** or **mitral valve**. The blood is carried from the heart by the **arteries**, and returned to it by the **veins**. The arteries and veins are connected in the tissues by the **capillaries**, which are exceedingly small vessels, with very thin walls, formed of a layer of endothelium.

The walls of the arteries are very strong and elastic; they have three coats; the outer coat is composed of connective tissue; the middle coat of muscular and elastic, in proportions

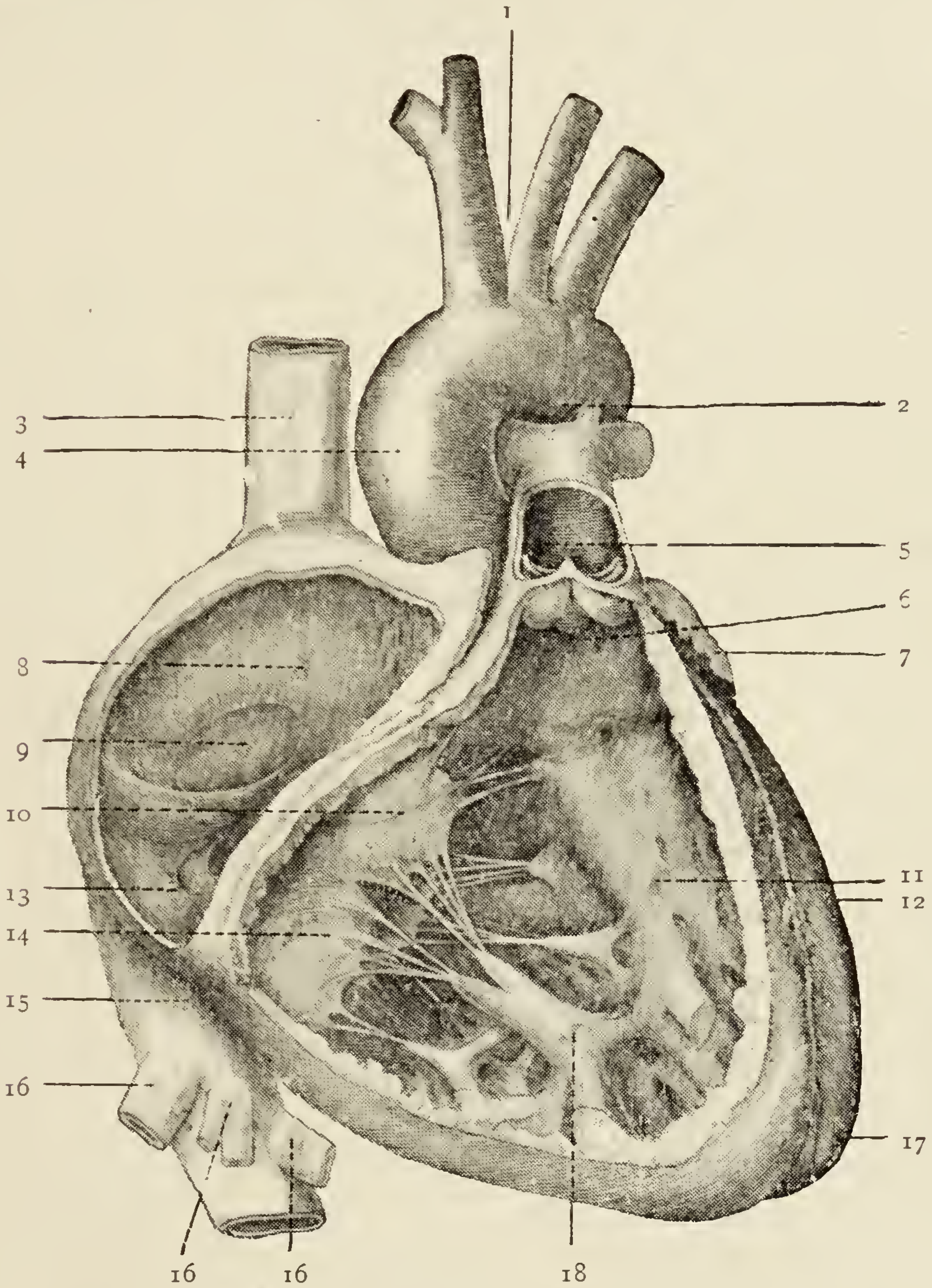

FIG. 18.—THE HEART. (BROADBENT.)

1, Innominate and left carotid arteries; 2, transverse part of arch; 3, vena cava superior; 4, ascending part of arch of aorta; 5, pulmonary artery; 6, pulmonic valves; 7, appendix of left auricle; 8, inter-auricular septum; 9, fossa ovalis with Eustachian valve below; 10, left segment of tricuspid valve; 11, inter-ventricular septum; 12, left ventricle; 13, coronary vein; 14, right segment of tricuspid valve; 15, inferior vena cava; 16, hepatic veins; 17, left ventricle; 18, anterior papillary muscle.

varying according to the size of the artery. The inner coat is a layer of fibrous and elastic tissue lined with endothelium. Arteries are contractile and elastic.

Veins have also three coats, but their walls are thinner and less muscular than those of arteries. There are two sets of veins—a deep and a superficial set, the former accompanying the arteries.

Veins are nearly all supplied with valves at short intervals; they are most numerous in the limbs; they are folds of the internal coat of the veins; their free edges are turned toward the heart, so a backward flow of blood is prevented.

Arteries are deeply set generally. The walls of arteries and veins are supplied with bloodvessels, which are called *vasa vasorum.* They are also supplied with nerves—the *vaso-motor.* The veins that accompany arteries are called *venæ comites.*

Arteries anastomose, or unite, at intervals, which admits of communication of blood, and promotes equal distribution.

Veins anastomose more frequently than arteries, and the deep and superficial veins communicate with each other.

SYSTEMIC OR GREATER CIRCULATION.

The blood leaves the heart by the aorta—the largest artery springing from the left ventricle—passes through all its branches to every part of the body, and is returned by the veins to the heart, being poured into the right auricle by the venæ cavæ.

The blood, which leaves the heart bright red and full of oxygen, in the capillaries becomes changed in colour and quality, and returns to the heart dark and laden with impurities. The interchange is effected by the oxygen and nutritive material oozing through the thin walls of the capillaries, and the carbonic acid gas and other impurities being sucked up by them; this causes the blood to become a purple colour; it is by this interchange that the tissues are nourished and waste substances removed.

It is in the capillaries that the principal work of the blood is done; they are fine hair-like vessels, which connect the arteries and veins and form a close network through nearly all the tissues, supplying every part with needful nutriment, and carrying off effete matter and material which may be reorganized and used again. They are most plentiful where blood is most needed, as in various organs. They supply the necessary substances for secretion to the glands; they take up the products of digestion in the intestines; in the kidneys they get rid of the waste collected from other parts; in the lungs they give up poisonous matter and take up oxygen. Capillaries are formed by the breaking up and subdivision of arteries; veins are formed by the union of capillaries, beginning with very small veins, which again unite to form larger ones. The blood flows more quickly in the large vessels, and is at its slowest in the capillaries.

PULMONARY OR LESSER CIRCULATION.

The impure or venous blood which is poured into the right auricle by the venæ cavæ passes into the right ventricle, and leaves the heart by the **pulmonary artery**, which divides in two, one part passing into the right lung, the other into the left. They go on dividing and subdividing till the capillaries permeate every part of the lungs and surround the air cells. It is here that the blood gives off carbonic acid gas and all impurities, and oxygen is absorbed by the red corpuscles from the freshly-breathed air. This renewed blood is collected by small veins, which unite to form larger ones, till they give rise to the **pulmonary veins**, two from each lung, which carry the blood to the left auricle. In this circulation it is the impure blood which leaves the heart, and purified blood which is poured into it; the capillaries give up carbonic acid and absorb oxygen, the arteries carry bad blood, and the veins carry good, all of which is quite the reverse of the greater circulation. Bloodvessels springing *from* the heart are always called **arteries**, and the vessels pouring *into* the heart always **veins**. These two circulations, starting from the ventricles and returning to the auricles, are always going on simultaneously; blood is poured into the auricles from the venæ cavæ and pulmonary veins, the auricles dilate to receive the blood, then contract, the tricuspid and mitral valves open, the ventricles dilate to receive the blood, then contract, the valves between them and the auricles close, and the semilunar valves open, and the blood is forced into the great arteries.

The semilunar valves at the entrances to these arteries prevent the blood from flowing back.

If the finger be placed on an artery, say, at the wrist or temple, an intermittent expansion of the artery will be felt; this is caused by the contraction of the heart, and constitutes what is called 'the pulse.' In the first few years of life the child's pulse averages 100 beats a minute; about fourteen or fifteen it has fallen to eighty, and in the man to seventy-two. It varies according to position, being slower when lying or sitting than when standing. It is increased by movement.

THE PORTAL CIRCULATION.

The gastric, splenic and mesenteric veins, which collect the venous blood from all the digestive organs, unite to form the **portal vein**, which carries to the liver this blood which has circulated through the capillaries of the stomach, spleen, pancreas and intestines, and though dark in colour, is laden with nutriment, the products of digestion. This important vein breaks up into capillaries (after the manner of an artery), and distributes this blood by means of them throughout the liver; it there mingles with blood supplied by the **hepatic artery**, and is collected again by small veins which unite to form the **hepatic vein**, by which it is carried to the inferior **vena cava**, and by it is poured into the right auricle.

THE CORONARY CIRCULATION.

In this the blood completes a circulation without leaving the heart; it enters the **coronary arteries** near the semilunar valves, passes through a capillary network, is collected by the **coronary veins**, and poured into the right auricle.

By the **systemic** circulation the blood is carried to all parts of the body for general nourishment.

By the **pulmonary** circulation blood is carried to the lungs to be oxygenated and purified.

By the **portal** circulation absorbed nutriment is carried to the liver to be elaborated.

By the **coronary** circulation the heart itself is supplied.

William Harvey discovered the circulation of the blood in 1619.

Malpighii discovered the capillaries in 1661.

CHIEF ARTERIES AND VEINS.

The **aorta** passes upwards and forms an arch over the root of the left lung, and then descends at the back of the heart and in front of the vertebral column; it passes out of the **thorax** by a special opening in the diaphragm, and ends in the abdomen opposite the fourth lumbar vertebra by dividing into the two common iliac arteries. The arch is divided into the ascending, transverse, and descending portions; the descending portion

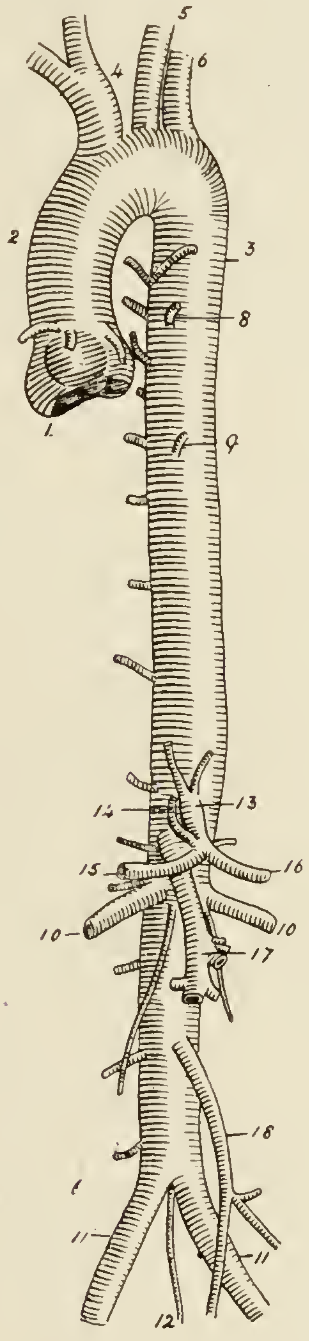

Fig. 19.—Aorta from Before.

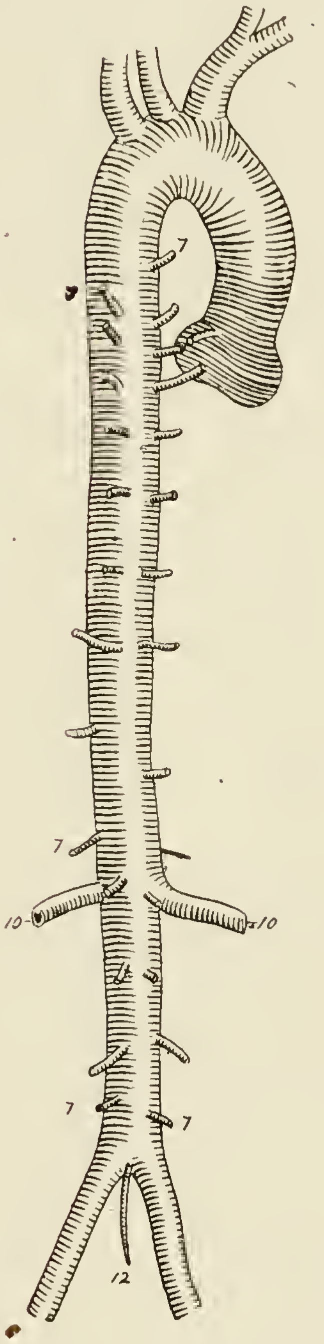

Fig. 20.—Aorta from Behind.

1 to 2; Ascending aorta; 2 to 3, arch of aorta; 4, innominate artery; 5, left carotid; 6, left subclavian; 7 to 7, intercostal and lumbar; 8, bronchial; 9, œsophageal; 10, renal; 11, common iliac; 12, middle sacral; 13, cœliac axis; 14, gastric artery; 15, hepatic; 16, splenic; 17, superior mesenteric; 18, inferior mesenteric.

above the diaphragm is called the **thoracic aorta**, and below the diaphragm the **abdominal aorta.** From the transverse portion three branches are given off—the **innominate**, the **left carotid**, and the **left subclavian arteries.** The **innominate artery** arises from the commencement of the arch, ascends obliquely to the right; near the articulation of the sternum with the clavicle it divides into the **right common carotid** and **right subclavian arteries.** The common carotid ascends the side of the neck to the thyroid cartilage, when it divides into the internal and external carotids. They are called external and internal, not because of their relation to each other, but because of their distribution.

The **right subclavian** arises at the bifurcation of the innominate, and the **left subclavian** from the arch of the aorta; they are the first part of the main artery of the upper limb.

The **internal carotid** ascends to the base of the skull, where it enters the carotid canal, through which it reaches the inside of the cranium; its chief branches are the ophthalmic and cerebral arteries, which supply the brain and eye.

The **external carotid** takes an upward course from the upper border of the thyroid cartilage, and ends between the mastoid process and the lower jaw by dividing into the temporal and maxillary arteries; it has eight branches, which are distributed to the throat, tongue, face, and walls of the cranium.

At the base of the brain the arteries anastomose in such a way with themselves and the vertebral arteries that they form a complete circle, known as the 'circle of Willis.'

These and other branches of the aorta will be studied in the parts through which they pass.

VENOUS RETURN.

The blood from the head is returned by the jugular veins.

The **external jugular vein** begins near the angle of the jaw by the union of two smaller veins, the auricular and the temporo-maxillary veins. It descends in a nearly vertical direction, and terminates in the subclavian vein.

The **anterior jugular vein** begins by the union of some small veins in the submaxillary region; it descends near the middle line, and opens into the external jugular or subclavian vein.

The venous system *within* the skull consists of veins and channels between the membranes, called sinuses, which receive the blood from the veins and convey it to the **internal jugular vein**, the largest venous channel of the neck. It enters the neck directly from the lateral sinus through the jugular foramen, and proceeds downwards to the inner end of the clavicle (receiving blood from the face, mouth, and throat), where it joins the subclavian and forms the **innominate vein.**

The blood from the limbs is returned by a superficial and deep set of veins.

The blood from the spine, walls of thorax and abdomen, is returned chiefly by the azygos veins.

ARTERIAL DISTRIBUTION.

Arch of aorta :

Right and left coronary.
Innominate { right common carotid. / right subclavian, axillary, brachial.
Left common carotid.
Left subclavian.
Axillary.
Brachial.
Ulnar { superficial palmar arch.   Radial { deep palmar arch.

Thoracic aorta :

Intercostal.
Pericardial.
Bronchial.
Œsophageal.

Abdominal aorta :

Cœliac axis { gastric. / hepatic. / splenic.
Superior mesenteric.
Inferior mesenteric.
Renal.
Ovarian.
Phrenic.
Lumbar.
Sacral.

Common iliac arteries :

External iliac.
Femoral, popliteal.
Internal iliac.

Post tibial { external plantar. / internal plantar. } plantar arch.
Anterior tibial.

VENOUS RETURN.

The veins from the head, face, and neck unite to form } external and internal jugular veins.

The deep-seated and superficial veins from the upper limbs unite to form } right and left subclavian veins.

The internal jugulars unite with subclavians to form } right and left innominate veins—unite to form **superior vena cava.**

The deep-seated and superficial veins from the lower limbs unite to form } external iliacs.
The veins from the pelvis unite to form } internal iliacs.
} Right and left common iliac unite to form **inferior vena cava.**

The veins from stomach, spleen, pancreas, and intestines unite to form the **vena porta.** The right and left azygos veins connect with the **inferior vena cava** and **superior vena cava.**

LYMPHATIC SYSTEM.

The Lymphatic System consists of lymphatic capillaries, vessels, glands and two ducts, the right lymphatic duct and the thoracic duct.

Lymph is a watery fluid resembling the plasma of the blood ; it contains white corpuscles called leucocytes, which are like the white corpuscles of the blood.

Lymphatic capillaries arise in all parts of the body that are supplied by blood. They begin in the spaces of the connective tissue and form networks all over the body. The larger trunks accompany the deep bloodvessels ; their walls are similar to those of the veins, but thinner ; like the veins, there is a superficial and a deep set, and like the veins also, they are provided with valves which permit the lymph to flow only in one direction; the valves, however, are more numerous than in the veins and give a beady appearance to the vessels.

Lymphatics do not carry to the tissues: they are absorbents; they absorb and carry away from the tissues all the material they do not need. All that the blood capillaries leave behind the lymphatic capillaries take up; some of this is waste and some is matter which may be used again. The lymph thus absorbed is collected by the lymphatic vessels, passed through the lymphatic glands, and finally emptied into the ducts.

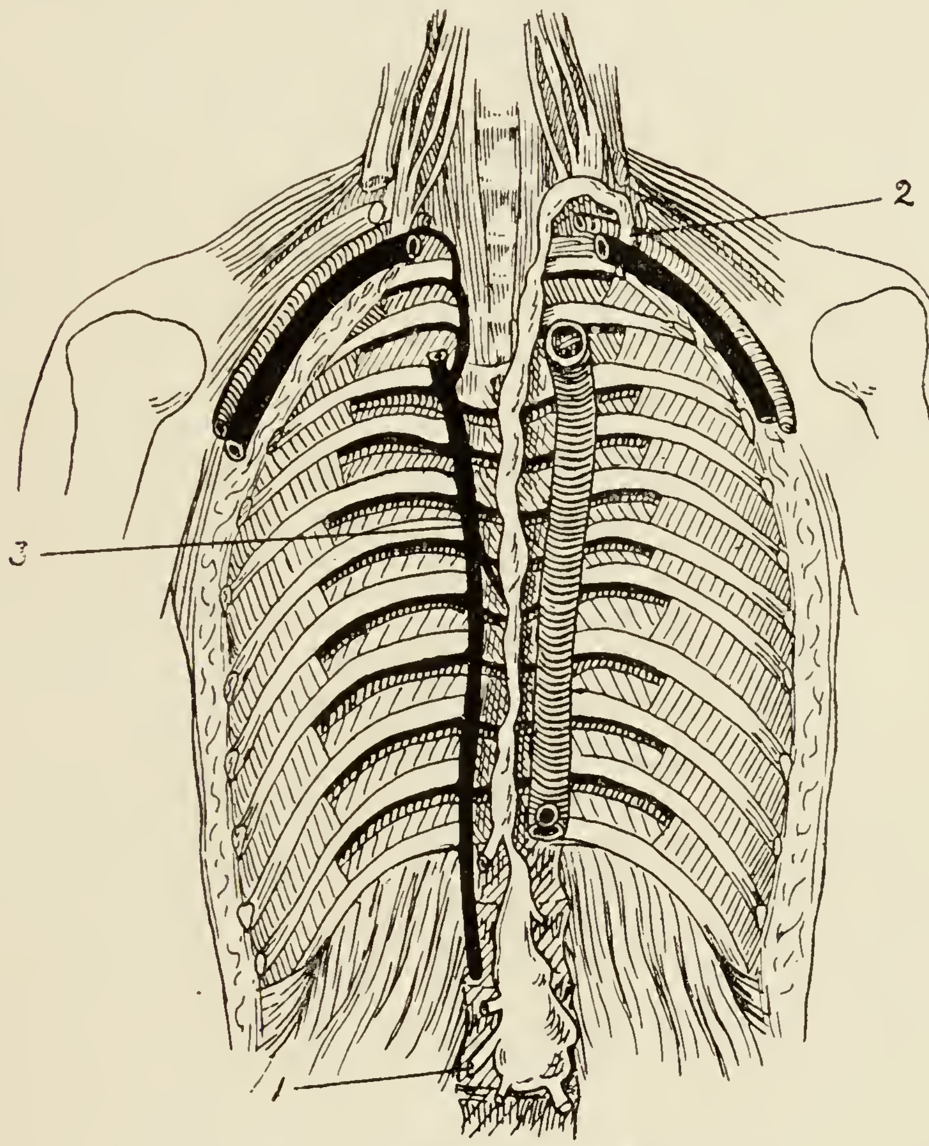

FIG. 21.—THE THORACIC DUCT.
1, Receptaculum chyli; 2, ending of duct; 3, azygos major vein.

The lymphatics of the right arm, of the right side of the head and upper part of the trunk, take up the lymph from these parts and carry it to the **right lymphatic duct**, which is a short vessel about an inch long, emptying into the innominate vein.

The vessels from the rest of the body, including those of the intestines, carry the lymph they collect to the **thoracic duct**, which extends from the second lumbar vertebra to the root of the neck. It lies in front of the vertebral column, inclining towards the left till it reaches the seventh cervical vertebra, when it arches forwards and downwards to pour its contents into the left innominate vein. It is about the size of a pencil, and is dilated at its lower end to receive the lymphatics from the lower limbs and most of the abdominal viscera ; this dilatation is called the **receptaculum chyli.**

The thoracic duct is provided with valves at short intervals, and there is a valve at the end to prevent the return of lymph or blood from the veins.

Lymphatic glands are small solid bodies, varying in size, through which the lymph passes on its way to the ducts; the lymphatics entering the glands are called **afferent**, those leaving them **efferent.**

There are numbers of glands in the neck, armpit and groin ; in the arm and leg they are found as far as the elbow and knee in the course of the large bloodvessels. There are some in the external part of the head. They are numerous in the thorax and abdomen, where they are called the **bronchial and mesenteric glands** ; they run along the aorta, inferior vena cava and iliac vessels. Lymphatic glands are well supplied with blood.

The lymphatics of the head and face pass through the glands of the neck, the **cervical glands.**

The lymphatics of the upper limbs and the greater part of the back and chest converge to the glands of the armpit, the **axillary glands.**

The lymphatics of the lower limbs and lower part of the trunk converge to the glands in the groin, the **inguinal glands.**

The small intestines are lined with mucous membrane, having numbers of small projections called **villi.** Each villus is supplied with a network of lymphatic capillaries, here called **lacteals,** as well as with blood capillaries ; these are surrounded by digested food, and absorption takes place rapidly both by the lacteals and bloodvessels ; they also lie in the mucous membrane between the villi. The large intestine contains fewer lymphatics, and they are not called lacteals.

Lacteals have the power of selecting fat from the products of digestion. It is the presence of fat that gives the milky appearance to the lymph in the lacteals during digestion, hence the name; at other times the fluid differs little from that of other lymphatics. This milky fluid is called **chyle**, and is collected by the lymphatic vessels. In passing through the lymphatic glands the number of oily particles diminishes, white corpuscles and fibrin are formed, and it becomes more like blood as it goes on to be mixed with it in the veins. There is a constant interchange going on between the blood and the lymph, by the process of osmosis. The lymph is in the first place derived from the blood; it is the blood plasma which has exuded through the walls of the capillaries, and through these same walls certain constituents of the lymph pass into the blood. The tissues are surrounded by lymph; it fills the spaces between the walls of the capillaries and the fibres of the tissues; each tissue takes from the lymph what it requires and returns used-up matter to the blood. Pressure on the tissues causes, by compressing the vessels, an onward flow of lymph, the return of which is prevented by the numerous valves.

The manipulations in massage must markedly affect the lymph flow. All muscular exercise does. Dr. M. Foster, in his 'Text-book of Physiology,' says: 'The widespread presence of valves in the lymphatic vessels causes every pressure on the tissues in which they lie to assist in the propulsion forward of the lymph. Hence muscular movements increase the flow. If a cannula be inserted in one of the larger lymphatic trunks of the limb of a dog, the discharge of lymph from the cannula will be more distinctly increased by movements, even passive movements of the limbs, than by anything else.'

It cannot, then, be doubted that massage has considerable effect on the lymph flow; contractions of the muscles are produced by kneading and percussion; these contractions force lymph out of the lymph spaces and cause it to be carried on through the vessels.

CHAPTER IV

THE NERVOUS SYSTEM

THE **nervous system** consists of two parts, the **Cerebro-spinal** and the **Sympathetic.** The **Cerebro-spinal** consists of the brain and spinal cord, with all the nerves given off by them. These nerves extend to all parts of the body and form the means of communication between the muscles and the great nerve centre, the brain and spinal cord.

The Sympathetic consists of a number of ganglia or knots of nerve matter, which give off nerve fibres and form a chain on each side of the vertebral column from the skull to the pelvis, communicating by fibres with the cerebro-spinal system.

The nerves of the sympathetic system are distributed to the viscera and to the coats of the bloodvessels. The lungs, heart, and upper and lower part of the alimentary canal receive nerves also from the cerebro-spinal system.

THE BRAIN.

The great nerve centre of the body, the brain, is the large upper portion of the cerebro-spinal axis, which fills the cavity of the skull. It consists chiefly of soft nerve substance, gray and white. The surface of the brain is covered by delicate connective tissue plentifully supplied with arteries, which supply the brain with blood. It is called the **Pia Mater** (soft or pious mother). Over this there is a delicate transparent serous membrane, the **Arachnoid** (spider's web). Over this there is a third, a tough and fibrous membrane, the **Dura Mater** (hard mother).

The principal divisions of the brain are the

Cerebrum,	**Pons Varolii,**
Cerebellum,	**Medulla Oblongata.**

The **cerebrum** or greater brain fills the upper and frontal portion of the cranium, and consists of two hemispheres, right and left, separated above by a deep fissure, but united below it. It is composed of gray matter, which surrounds white fibrous nerve substance. The gray matter is drawn up into a great number of convolutions, or folds, by which its surface is

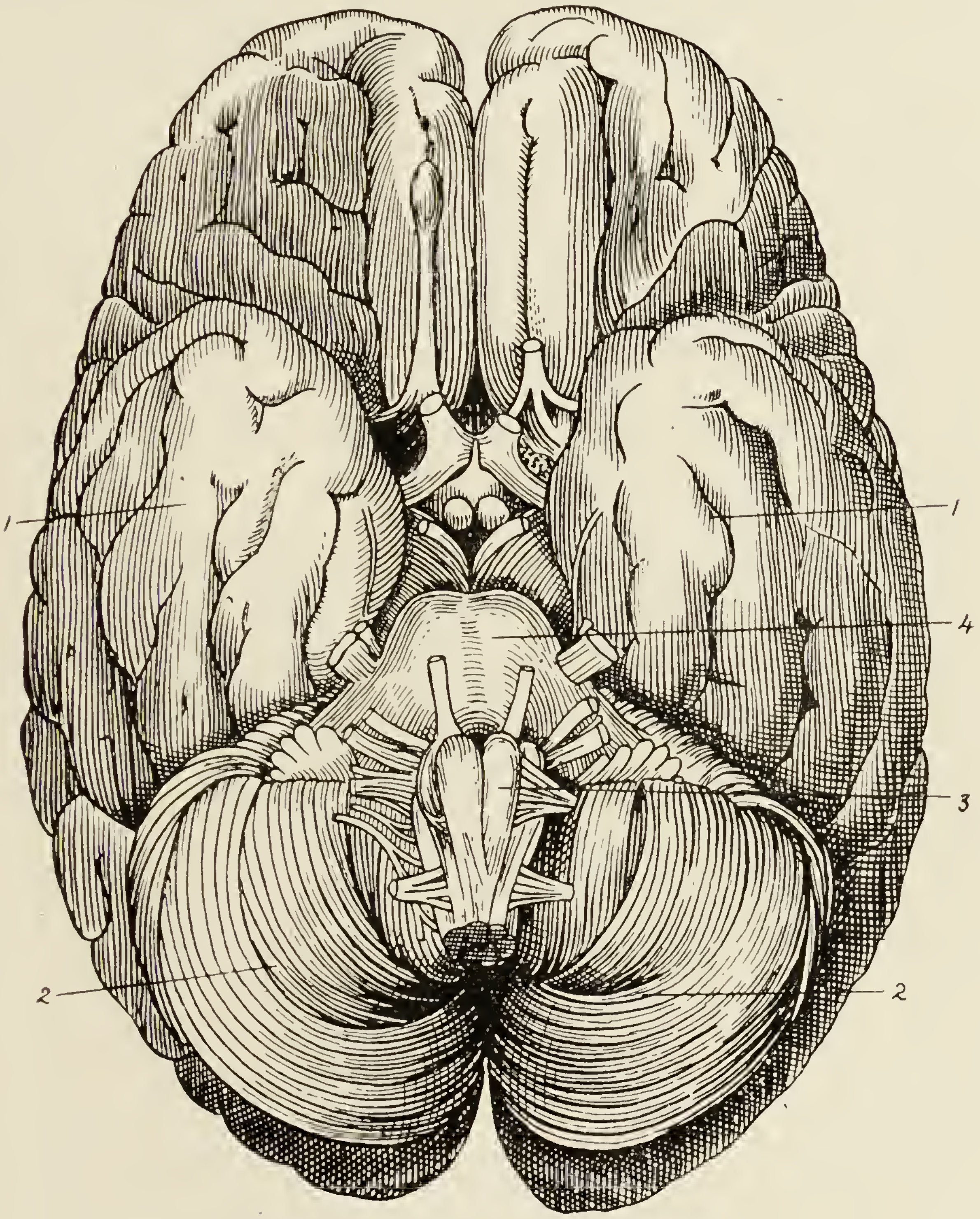

FIG. 22.—UNDER SURFACE OF BRAIN.
1, Cerebrum; 2, cerebellum; 3, medulla oblongata; 4, pons varolii.

increased; the pia mater dips between these folds, the other two coverings pass over them. The cerebrum is the seat of intelligence, will, emotion, and sensation. When the cerebrum of an animal is removed, it loses the power of voluntary movement and lies in a state of stupor, but it retains the power of performing involuntary actions.

The **cerebellum**, or lesser brain, lies under the back portion of the cerebrum, and also consists of two hemispheres, each composed of an external layer of gray matter surrounding white fibrous substance. Its convolutions are different to those of the cerebrum, but the pia mater dips between them. The function of the cerebellum seems to be the co-ordination of muscular movements. When the cerebellum of an animal is removed, it retains sensation, and can move voluntary muscles, but it cannot walk, nor can it balance its body. Voluntary movements do not originate in the cerebellum, only the power of co-ordinating these movements.

The pons varolii is a broad band, or bridge, of nerve matter which unites the cerebrum, cerebellum and medulla oblongata.

The medulla oblongata lies below the pons; in this the gray matter is interior, and surrounded by the white.

It contains important nerve centres, which govern the involuntary movements concerned in breathing, swallowing, etc. If it is destroyed, death immediately ensues. Nerve fibres decussate or cross in the medulla. The result of this is that injuries to nerve centres on the right side of the brain will affect the left side of the body and *vice versâ*.

THE SPINAL CORD.

The spinal cord is a continuation of the brain extending from the medulla to the second lumbar vertebra; its lower end tapers to a point. Before its termination it breaks up into a number of fibres, which, from their resemblance to a horse's tail, are called **cauda equina.** It lies in the spinal canal, which is a bony tube formed by the vertebræ, being arranged one above the other. It is divided into right and left parts by two fissures. As in the medulla, the gray matter of the cord is in the interior, and is surrounded by the white.

It is from 16 to 18 inches in length, and its diameter is about $\frac{3}{4}$ of an inch. Like the brain, it is enveloped in three membranes: the pia mater closely invests it and is adherent to its surface, the arachnoid and dura mater form loose investments.

The cord and its covering membranes are supplied by small arteries, which enter the spinal canal through the spaces between the vertebræ. In the cervical and lower dorsal regions of the spinal cord there are two swellings, called the cervical and lumbar enlargements, from which proceed the nerves that supply the upper and lower limbs. From the under surface of the brain twelve pairs of nerves are given off. From the spinal cord thirty-one pairs of nerves are given off. The nerve fibres which conduct impulses to a nerve centre are called afferent, or sensory. Those which conduct impulses from a nerve centre are called efferent, or motor. By the former we feel pain or any other sensation. The latter are distributed entirely to the muscles, and by stimulating them produce motion. Some nerves have both sensory and motor fibres running through them, and convey impulses in both directions; these are called mixed nerves.

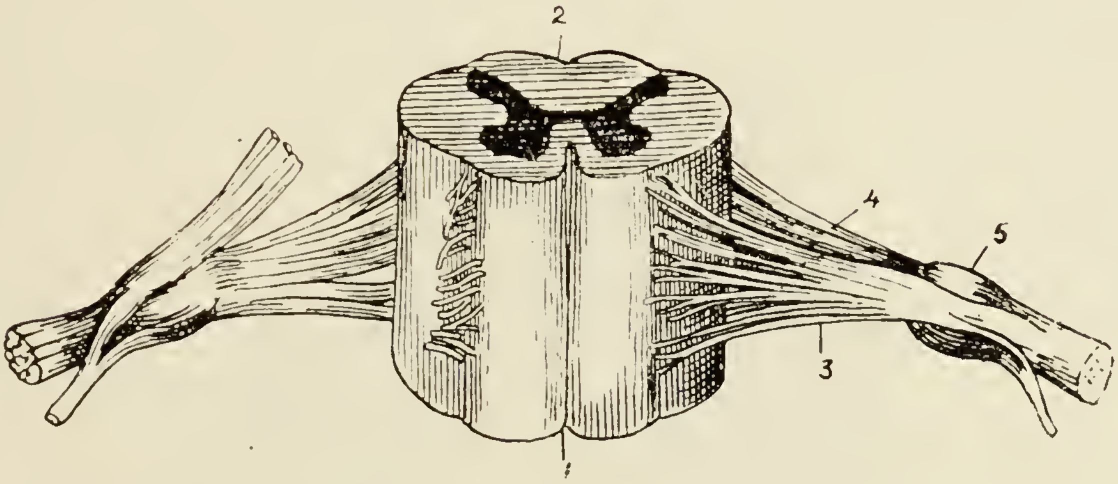

FIG. 23.—SECTION OF SPINAL CORD AND NERVE ROOTS.
1, Anterior fissure; 2, posterior fissure; 3, anterior root; 4, posterior root; 5, ganglion.

CRANIAL NERVES.

Twelve nerves arise from the brain on either side of the middle line, and pass out through openings in the skull. With the exception of the two first and the eleventh, they all arise from the gray matter in the medulla oblongata. They are—

(1) **Olfactory,**
(2) **Optic,**
(3) **Motor Oculi,**
(4) **Trochlear,**
(5) **Trifacial,**
(6) **Abducens,**
(7) **Facial,**
(8) **Auditory,**
(9) **Glossopharyngeal,**
(10) **Pneumogastric,**
(11) **Spinal Accessory,**
(12) **Hypoglossal.**

First, or **olfactory**, is the special nerve of sense of smell. Its fibres pass through the holes in the ethmoid bone to the mucous membrane of the nose (sensory).

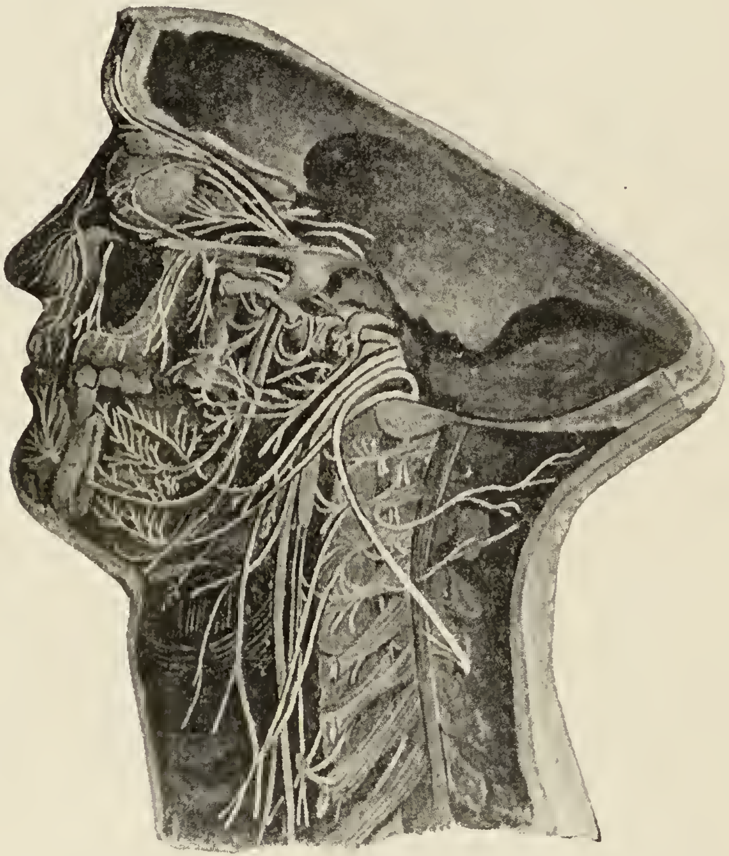

FIG. 24.—CRANIAL NERVES OF LEFT SIDE.

Second, or **optic**, is the special nerve of sight. It enters the orbit through the optic foramen, and is distributed to the interior of the eyeball (sensory).

Third, or **motor oculi**, enters the orbit of the sphenoidal fissure, and supplies all the muscles of the eye, except the superior oblique and external rectus (motor).

Fourth, or **trochlear**, enters the orbit with the motor oculi, and supplies the superior oblique muscle only (motor).

Fifth, or **trifacial**, or **trigeminal**, is the largest cranial nerve. It has three divisions: (1) The ophthalmic, which leaves the cranium through the sphenoidal fissure, and sends branches to the skin of the forehead, the lachrymal gland, the eye, and the nose (sensory). (2) The superior maxillary leaves the cranium by the foramen rotundum; it supplies the skin of the temple, cheek, nose, upper lip, upper teeth, and the mucous lining of the mouth and pharynx (sensory). (3) The inferior maxillary leaves the cranium through the foramen ovale; it gives branches to the temple and external ear, the teeth, and lower jaw, and supplies the tongue with a nerve of taste (motor and sensory).

Sixth, or **abducens**, enters the orbit by the sphenoidal fissure, and supplies the external rectal muscles of the eye only (motor). The muscles of the eye are therefore supplied by the third, fourth, and sixth nerves, which all pass out through the sphenoidal fissure. The second, and a branch from the fifth, supply the eye with special and ordinary sensations. The eye, therefore, has five nerves.

Seventh, or **facial**, leaves the cranium by the stylo-mastoid foramen; it supplies all the muscles of expression of the face, and some muscles of the neck and ear (motor).

Eighth, or **auditory**, is the special nerve of hearing, and is distributed only to the internal ear (sensory).

Ninth, or **glosso-pharyngeal**, is a nerve of taste, and also supplies the muscles and mucous membrane of the pharynx (sensory and motor).

Tenth, or **pneumogastric**, is a very important nerve; it is also called the vague or wandering nerve, because of its wide distribution, having a longer course than any other cranial nerve. It passes out from the skull with the glosso-pharyngeal and spinal accessory nerves through the jugular foramen. It supplies branches to the pharynx, larynx, heart, lungs, œsophagus, liver, and stomach (motor and sensory).

Eleventh, or **spinal accessory**, nerve consists of two parts, a spinal and an accessory. The spinal ascends from the spinal cord through the foramen magnum. The accessory is connected with the vagus; it supplies the trapezius and sterno-mastoid muscles (motor).

Twelfth, or **hypoglossal**, nerve leaves the cranium through the anterior condyloid foramen, and supplies the muscles of the tongue (motor).

SPINAL NERVES.

Thirty-one spinal nerves pass out on each side of the spinal cord through the intervertebral foramina. They correspond in name with the bones with which they are associated, thus:

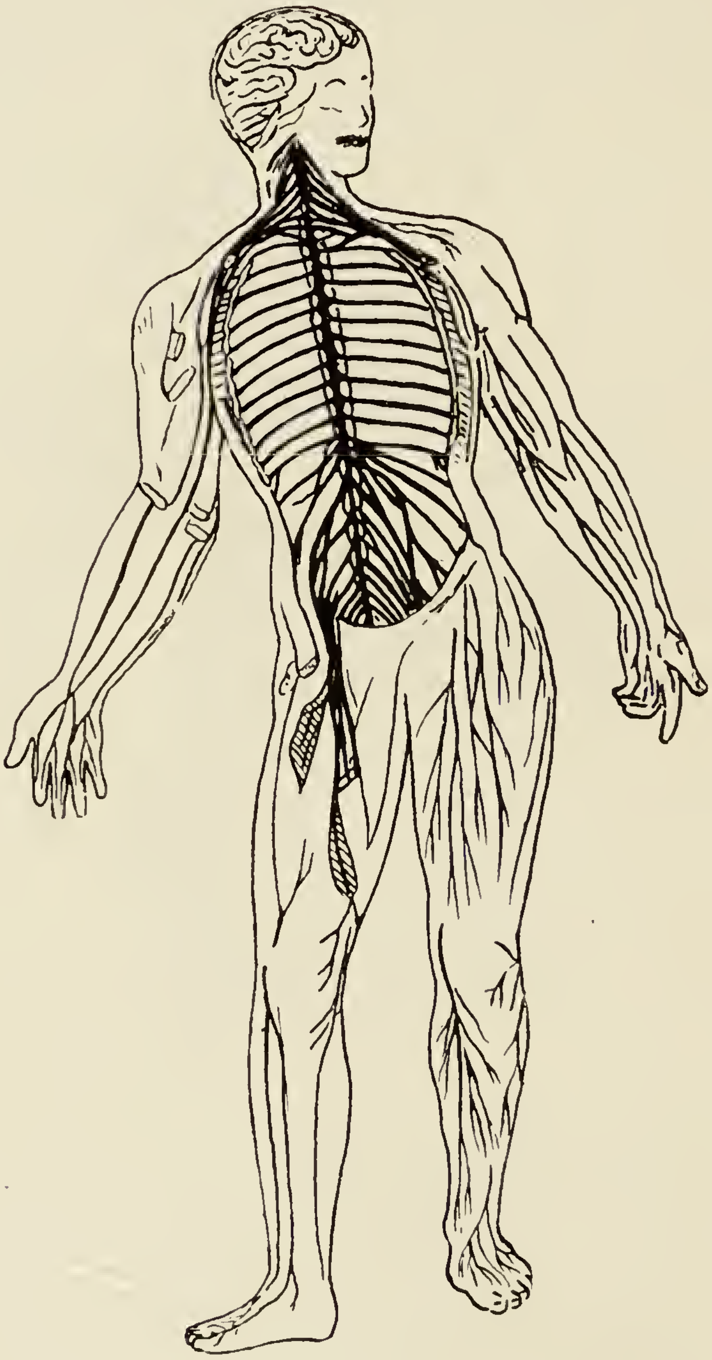

FIG. 25.—CEREBRO-SPINAL SYSTEM.

Cervical (8),
Dorsal (12),
Lumbar (5),
Sacral (5),
Coccygeal (1).

Each nerve has two roots, an anterior and a posterior, which arise from two cornua, or horns, formed by projections backward and forward of the gray matter of the cord. The anterior root is composed of motor fibres, the posterior root of sensory fibres. On the posterior nerve roots there are swellings, called ganglia; immediately beyond these ganglia the two roots unite and form a nerve trunk, which is very short, as it immediately divides into the anterior and posterior primary divisions. Each division contains fibres from both roots, so all the spinal nerves in their distribution are mixed nerves—that is, they contain both sensory and motor fibres.

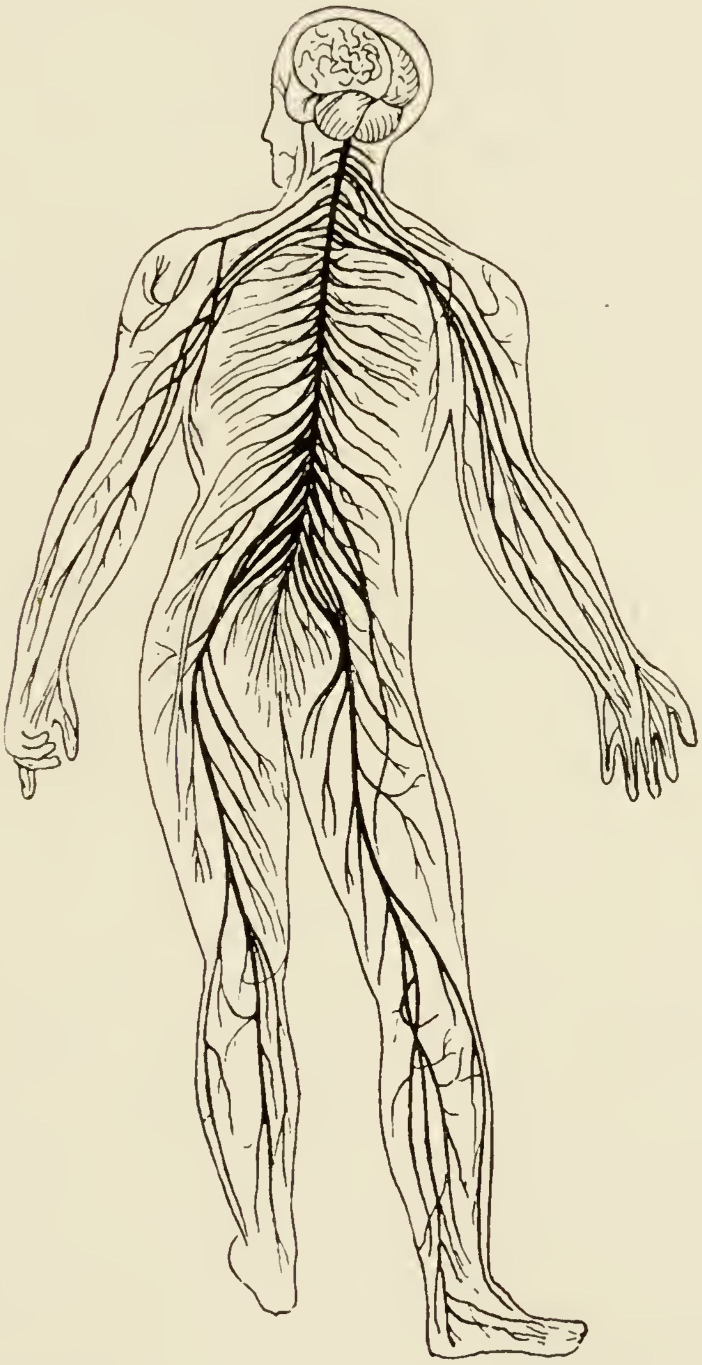

FIG. 26.—CEREBRO-SPINAL SYSTEM.

The motor or efferent fibres of the anterior root are distributed to the muscles, and cause their contractions. If the anterior root of the nerves supplying a certain part be injured, loss of power results in that part, though feeling remains.

The sensory or afferent fibres end in the skin, and convey impressions of feeling to the brain; on entering the spinal cord they cross over to the opposite side, and by it are conducted upwards. If the posterior root of the nerves supplying a certain part be injured, loss of feeling will result in that part, though power of movement remains.

If a nerve composed of efferent and afferent fibres be injured, sensation and movement are both lost in the part supplied by that nerve. If the spinal cord be injured, there will be loss of sensation and of power of movement in the body below the injury; but the parts above the injury will continue to have their ordinary power.

REFLEX ACTION OF THE SPINAL CORD.

The **spinal cord** is the medium by which motor and sensory impressions are conducted to and from the brain. It receives impressions from all parts of the body by means of the sensory nerves, and conveys them to the brain, where they produce sensation. It conducts the command of the brain to the voluntary muscles by the motor nerves, and thus causes movement. In all this the brain is the power, and the cord the conductor; but, as well as this, the cord has a special function —that of reflex action. If the connection of the cord with the brain be severed, and the skin supplied by afferent nerves below the injured part be irritated, movement will be produced in the part supplied by efferent nerves from the same part of the cord. This is reflex action.

The irritation of an afferent nerve connected with the spinal cord sends an impulse to a nerve centre (gray matter) in the cord, and without communication with the brain this nerve centre has the power of sending back an impulse by an efferent nerve (or nerves), producing contraction of the muscle or muscles in which the efferent fibres terminate. A person paralyzed from spinal injury will thus draw up his legs and kick out when the soles of his feet are tickled. Both in the brain and cord active power is confined to the gray matter.

The brain itself gives rise to reflex actions—actions which take place without the will or consciousness of the individual, such as instinctive shrinking from a threatened blow, or blinking from a flash of light.

SPINAL NERVES.

Posterior Primary Division.

The **posterior primary division** of the spinal nerves nearly all divide into internal and external branches, which supply the muscles and skin of the back. The first cervical, two lowest sacral, and coccygeal are the nerves which do not divide.

Anterior Primary Division.

The various plexuses of nerves are formed by nerves from the anterior primary division. A plexus means an interlacing of nerves or bloodvessels; in this case it means nerves. The nerves from this division supply the limbs and the front and side of the neck, thorax, and abdomen.

Cervical Plexus.

This plexus is formed by the upper four cervical nerves. The lower three each divide into an ascending and descending branch, which, joining together, form the plexus. It is opposite the first four upper vertebræ, beneath the upper part of the sterno-mastoid muscle, and in front of the scalenus medius and levator anguli scapulæ muscles. Its branches are numerous; a superficial set supply the cervical fascia, the skin of the head and neck, and part of the ear and face; a deep set are distributed to the muscles of the neck and the upper part of the back. The most important nerve of this plexus is the phrenic; it arises mainly from the fourth cervical nerve, and enters the thorax behind the subclavian vein, and proceeds down to the diaphragm, where it breaks into several branches, which pierce the muscle and spread out on its under surface to supply it. The diaphragm is the great muscle of respiration, and any

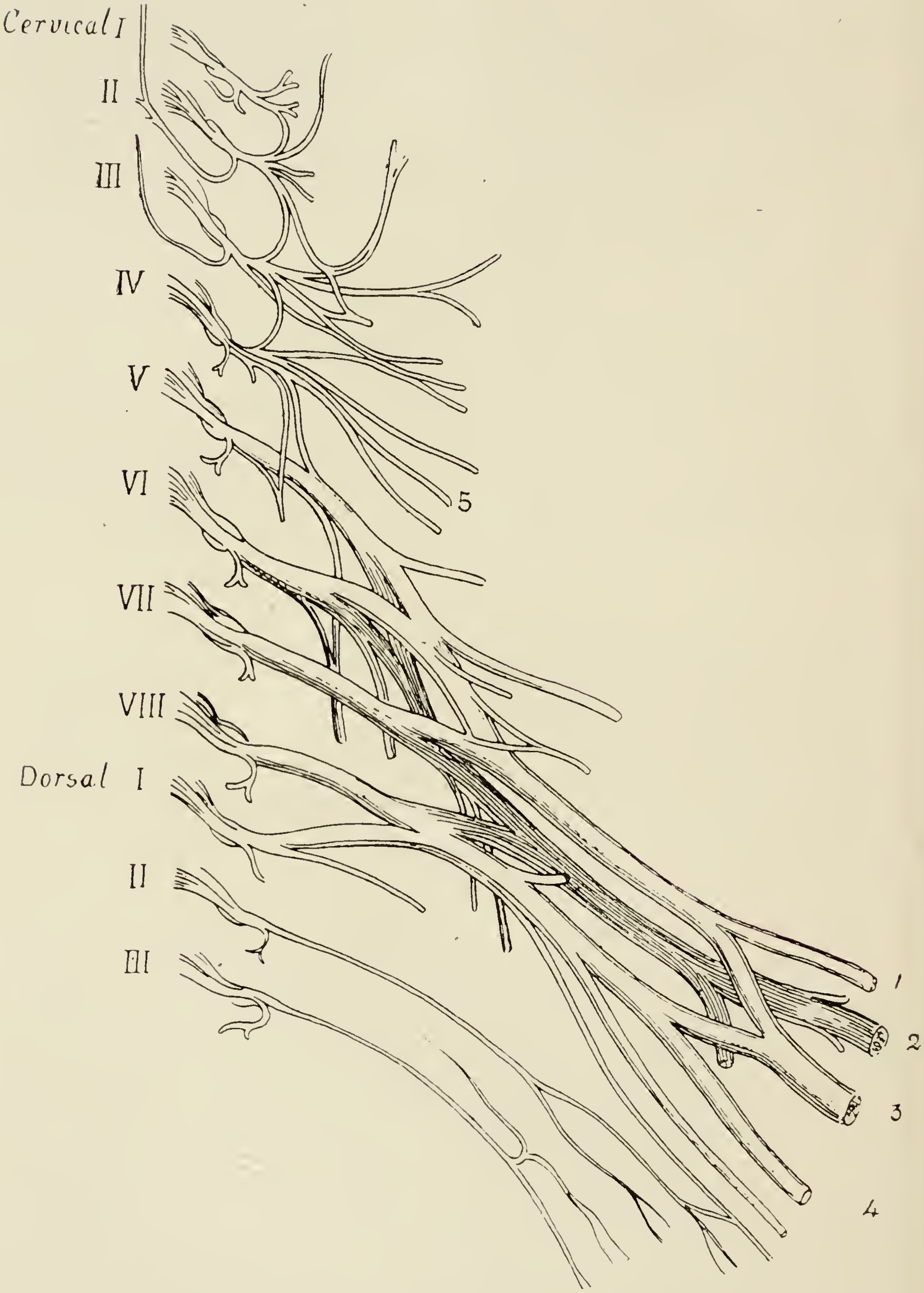

Fig. 27.—Cervical and Brachial Plexus.
1, Musculo-cutaneous; 2, musculo-spiral; 3, median; 4, ulnar; 5, phrenic.

injury to the phrenic nerve or to the spinal cord above the origin of its fibres causes paralysis of the diaphragm and *immediate death.*

Brachial Plexus.

This plexus is formed by the union of the four lower cervical and first dorsal nerves. It extends from the lower part of the neck to the upper part of the axillary space, and terminates opposite to the coracoid process of the scapula in three cords—outer, inner, posterior—which supply nerves to the upper limb.

The branches of the brachial plexus are divided into those which are given off at the root of the neck above the clavicle, and those given off in the axilla below the clavicle. A connection is established between the cervical and brachial plexuses by the descending branch of the fourth nerve uniting with the fifth nerve.

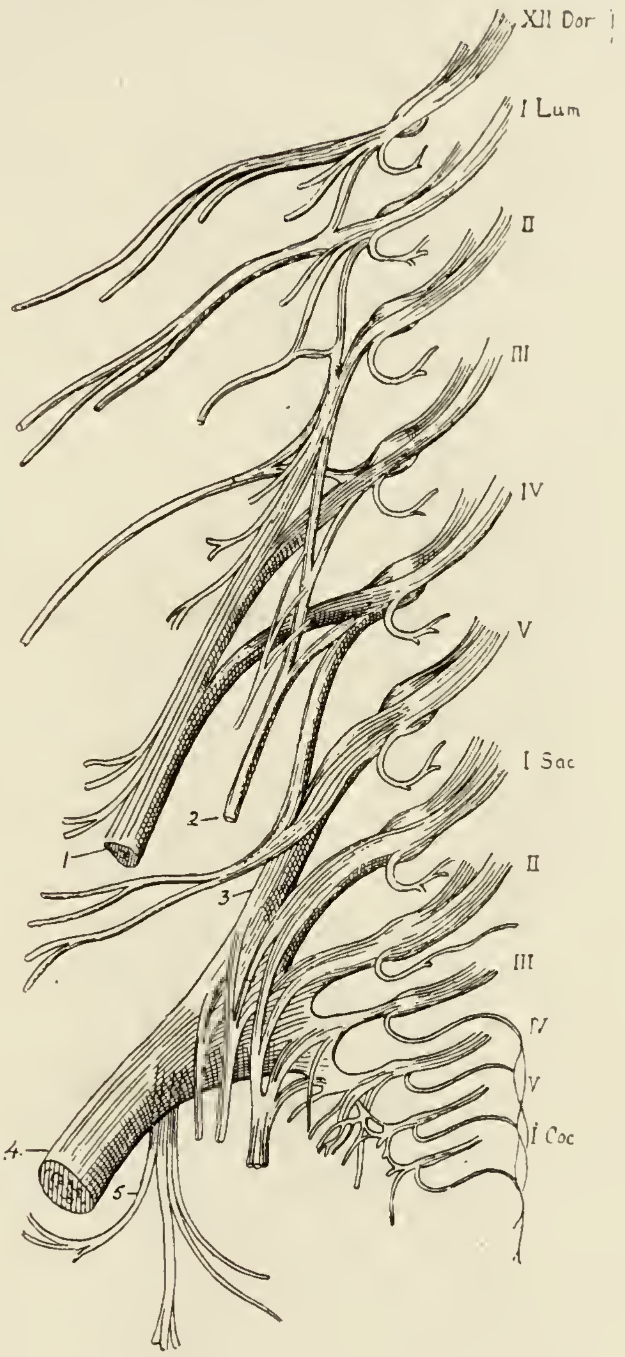

FIG. 28.—LUMBAR AND SACRAL PLEXUSES.

1, Anterior crural nerve (from 2, 3 and 4, lumbar nerves); 2, obturator nerve (from 2, 3 and 4, lumbar nerves); 3, lumbar sacral cord (from 4 and 5, lumbar nerves); 4, great sciatic nerve (from lumbar sacral cord and 1, 2 and 3, sacral nerves); 5, lesser sciatic nerve (from 2 and 3, sacral nerves).

Lumbar Plexus.

This plexus is formed by the union of the first three and part of the fourth lumbar nerves. It lies in the substance of the psoas muscle in front of the transverse processes of the lumbar vertebræ. It has numerous branches, which supply the skin and muscles of the thigh.

The first lumbar trunk breaks up into four branches. The second, third, and fourth trunks each divide into an anterior and posterior division; the three anterior unite to form the obturator nerve, which issues from the pelvis by the obturator or thyroid foramen.

The three posterior unite to form the anterior crural nerve, the largest branch of the plexus, which passes out of the pelvis behind Poupart's ligament, between the psoas and iliacus muscles.

The lumbar plexus is connected by a small branch with the last dorsal nerve, and with the sacral plexus by the lumbo-sacral cord, which is a large nerve trunk formed by the union of the fourth and fifth lumbar nerves; it passes over the sacrum and joins the sacral plexus.

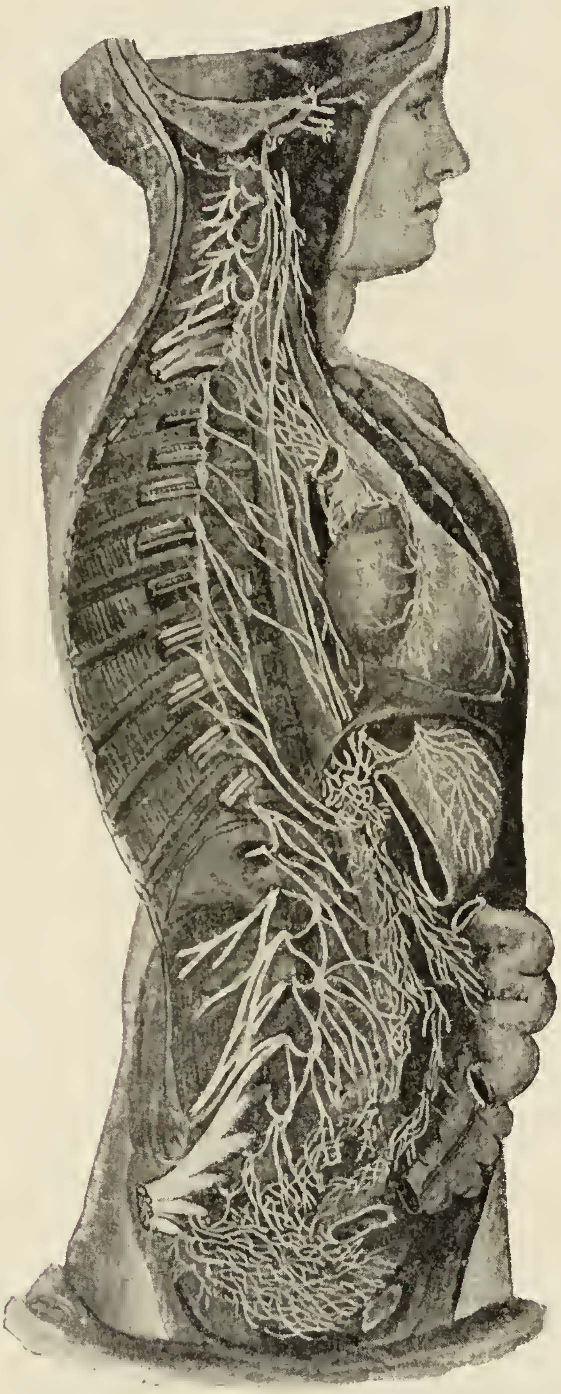

FIG. 29.—CHAIN OF SYMPATHETIC SYSTEM (RIGHT SIDE).

Sacral Plexus.

The first three sacral nerves, a branch of the fourth, and the lumbo-sacral cord form this plexus. The first sacral, with portions of the second and third nerves and the lumbo-sacral cord, form the sciatic band, which, proceeding to the great sciatic foramen, issues through it from the pelvis as the great sciatic nerve.

The various nerves of these plexuses will be gone into in later chapters.

Sympathetic System.

From the gangliated cord which lies at each side of the spinal column an external and internal series of branches are given off.

By the external branches the ganglia are connected with the spinal and cranial nerves in their respective neighbourhoods. Some fibres pass from the ganglia to the spinal nerves; others pass from the spinal nerves to the ganglia. Fibres from the cervical ganglia join the cranial nerves; thus the whole nervous system is united.

The internal branches are distributed to the viscera and to the walls of the bloodvessels. In the viscera they are joined by branches from the cerebro-spinal system, and form plexuses about the heart, lungs, stomach, and other organs, and to a certain extent control their functions. In the bloodvessels they regulate the supply of blood to the various parts of the body. **Vaso-motor nerves** are of two kinds—**vaso-constrictors** and **vaso-dilators.** Under the influence of the former the arterial walls are caused to contract, and the flow of the blood through them is retarded. This explains the act of turning pale as the result of some emotion. The action of the vaso-dilators is the reverse of this; the influence of some emotion is extended to the sympathetic system, and causes dilation of the arteries, and a greater quantity of blood is allowed to pass. This explains the act of blushing.

The most important vaso-motor nerves are the **splanchnic.** There are three.

The **great splanchnic nerve** is formed by branches from the sixth to the tenth ganglia of the cord, and ends chiefly in the semilunar ganglia of the solar plexus.

The **small splanchnic nerve** is formed by branches from the tenth and eleventh ganglia of the cord, and ends in the cœliac plexus.

The **smallest splanchnic** arises from the twelfth ganglion, and ends in the renal plexus. In connection with the sympathetic system there are three large plexuses in front of the spinal column, called the pre-vertebral plexus. They are the

Cardiac,
Solar, or **epigastric,**
Hypogastric.

The **cardiac plexus** is behind the aortic arch upon the lower end of the trachea. It is formed by the interlacement of the cardiac branches of the sympathetic and pneumogastric nerves.

The **solar plexus** is behind the stomach, in front of the aorta and pillars of the diaphragm ; it is the largest of the three, and is formed by branches of the pneumogastric and great splanchnic nerves. On each side of it there is a ganglion called the semilunar, the upper part of which is joined by the great splanchnic nerve, and the lower part by the small splanchnic nerve. The two semilunar ganglia are joined by the cœliac plexus, and other secondary plexuses arise from the cœliac.

The **hypogastric plexus** is in front of the body of the last lumbar vertebra, between the two common iliac arteries. It is formed by branches of the aortic plexus and lumbar ganglia. The pelvic viscera is mainly supplied with nerves from it. At the lower part it divides into two parts, which go down the sides of the rectum and join other small plexuses.

CHAPTER V

THE UPPER LIMB

BONES.

Clavicle,	or	collar-bone	Form shoulder girdle.
Scapula,	,,	shoulder-blade	
Humerus,	,,	bone of upper arm.	
Ulna and Radius,	,,	bones of forearm.	
Carpal,	,,	bones of wrist.	
Metacarpal,	,,	bones of palm.	
Phalanges,	,,	bones of fingers.	

The **clavicle** is commonly known as the collar-bone. It articulates by one end with the sternum (breast-bone) and by the other end with the acromion process of the scapula. It tends to keep the shoulders back.

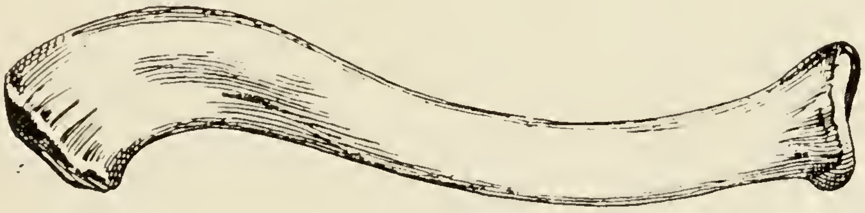

FIG. 30.—CLAVICLE.

The **scapula** is a flat triangular bone traversed at the back by a ridge, the spine of the scapula, which ends in the acromion process. There is another process called the coracoid, which arises from the top of the glenoid cavity. These two processes overhang the joint, and help to keep the humerus in place. The scapula has a shallow socket, the glenoid cavity, which receives the head of the humerus, and forms the shoulder-joint. In life this cavity is deepened by a rim of fibro-cartilage, the glenoid ligament; the shallowness of the cavity renders the humerus liable to dislocation, but permits great freedom of movement, which is further secured by laxity of the ligaments which bind the bones together. The narrow part of the scapula behind the cavity is the neck.

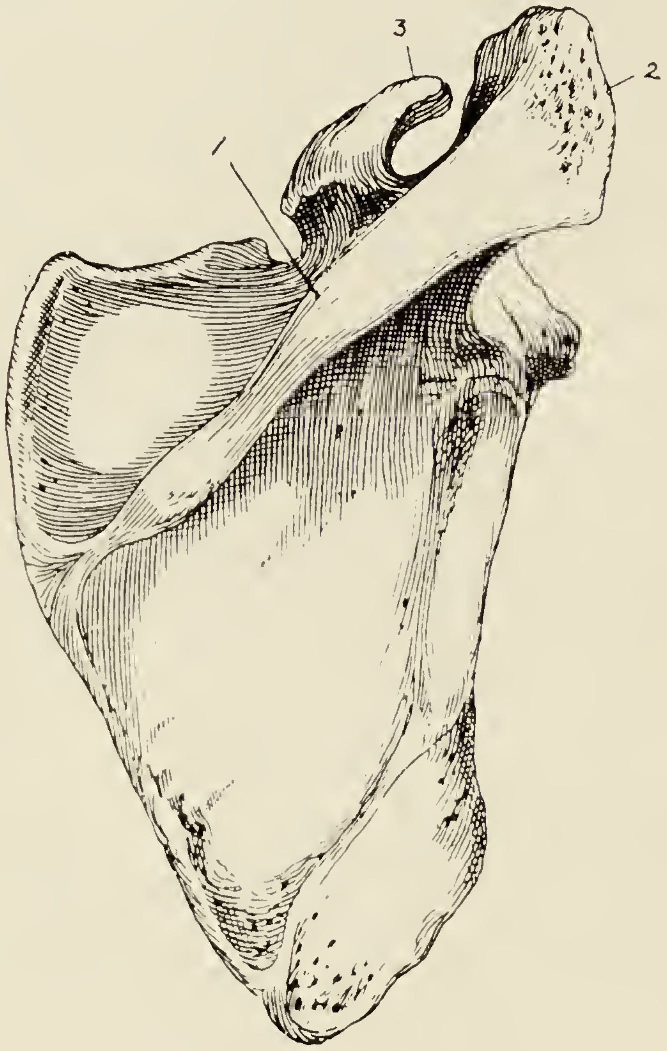

FIG. 31.—SCAPULA.
1, Spine; 2, acromion process; 3, coracoid process.

The under or anterior surface of the scapula is smooth, and glides over the back of the chest.

The Arm.

The **humerus** is a long cylindrical bone. The superior head is round and covered with cartilage; just below it is the *anatomical* neck; further down, below the tuberosities, is the *surgical* neck. There are two tuberosities, the *greater* on the outside and the *lesser* on the inside; between them is the bicipital groove. This groove is lined with cartilage, and receives the tendon of the long head of the biceps (a muscle on the front of the arm). The ridges at each side form points of attachment for muscles of the trunk. The shaft has an oblique depression going down the outer aspect, called the musculo-spiral groove, through which the musculo-spiral nerve runs.

The bone is somewhat twisted. The lower end is flattened, and has two projections called condyles, an inner and an outer. At the back, between the two condyles, is a fossa, or depression, into which the olecranon process of the ulna fits when the forearm is extended; in front there is a smaller fossa, into which the coronoid process of the ulna fits when the forearm is flexed.

An articulating surface on the inner side for the ulna is called the trochlear surface, and that for the radius on the outer side is called the capitellum. They are separated by a narrow groove. Most of the muscles of the forearm and hand arise from the condyles of the humerus.

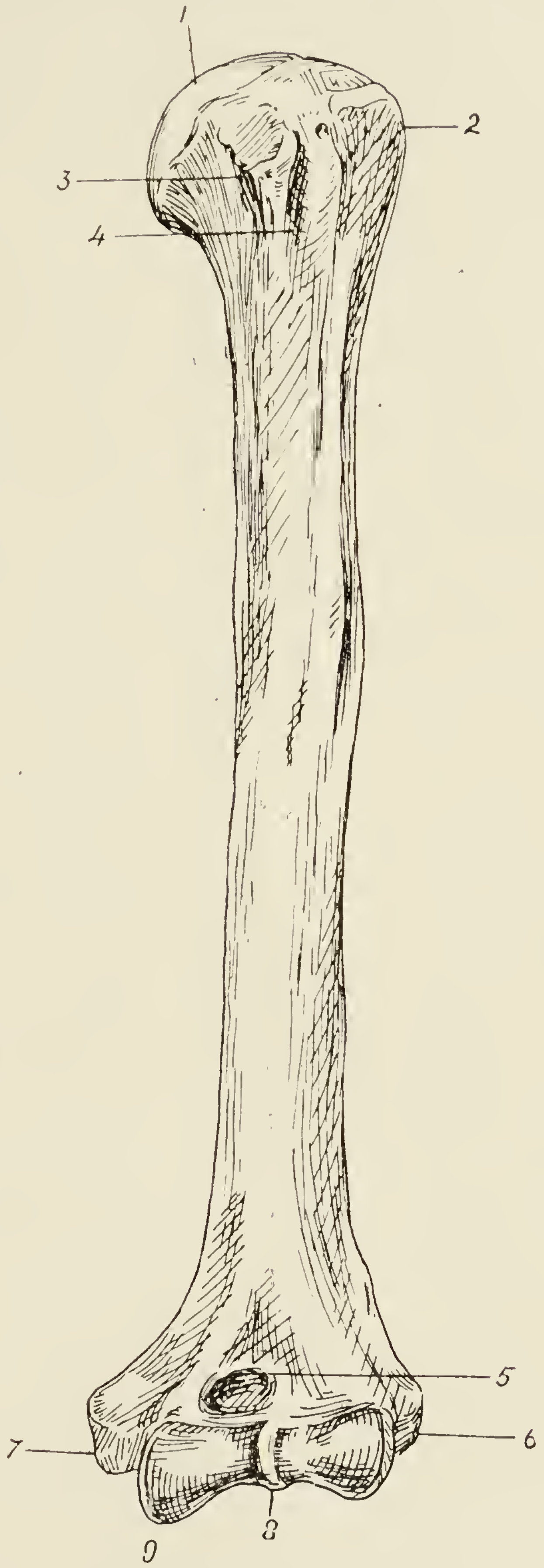

FIG. 32.—HUMERUS.

1, Head; 2, great tuberosity; 3, lesser tuberosity; 4, bicipital groove; 5, coronoid fossa; 6, external condyle; 7, internal condyle; 8, trochlea; 9, capitellum.

The Forearm.

The articulation of the superior heads of the ulna and radius with the humerus forms the elbow-joint. The ulna is an irregularly shaped bone. The upper head has two processes, the olecranon behind, and the coronoid in front; the cavity formed by these two processes is called the greater sigmoid cavity, because it is supposed to resemble the Greek letter *sigma* (*s*). The trochlear of the humerus fits into the sigmoid cavity, and thus forms a hinge-joint. A projection at the lower end of the ulna is called the styloid process.

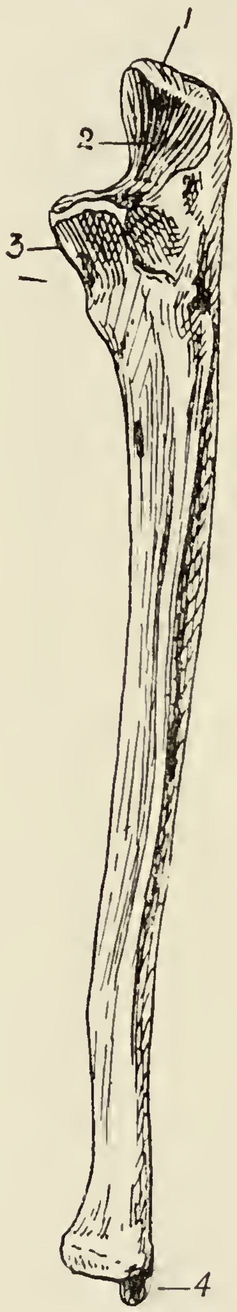

FIG. 33.—ULNA.

1, Olecranon; 2, great sigmoid cavity; 3, coronoid process; 4, styloid process.

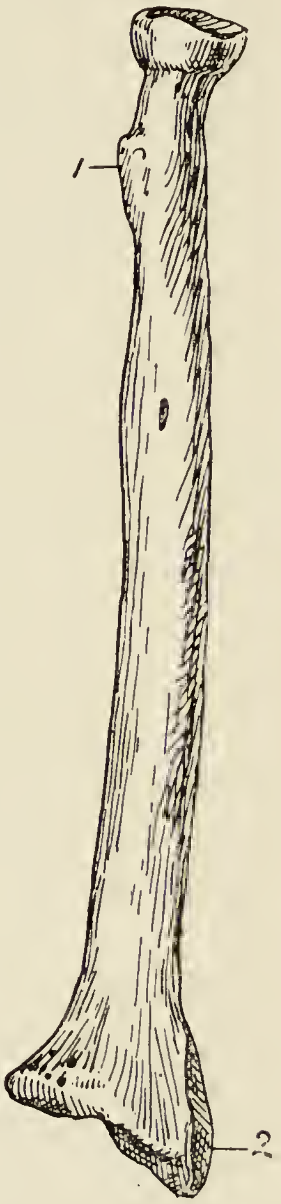

FIG. 34.—RADIUS.

1, Bicipital tuberosity; 2, styloid process.

The radius is the outer bone of the forearm. The upper head is small and button-shaped, with a rim round it. It rotates on the capitellum of the humerus, and forms a pivot-joint. The inner side of the rim rolls in a small cavity in the outer side of the ulna, called the lesser sigmoid cavity, and forms the superior radio-ulnar joint. The neck is surrounded by a ligament in which it rotates, and which is attached to the ulna, in front of and behind the lesser sigmoid cavity. Below the neck on the inner side is a prominence called the bicipital tuberosity, into which the lower end of the biceps muscle is inserted. At the lower end there is another small sigmoid cavity, with which the lower end of the ulna articulates, and forms the inferior radio-ulna joint. The radius has a projection at the lower end called the styloid process.

The Hand.

There are twenty-seven bones in the hand. Eight small bones form the wrist, two rows of four bones each.

Counting from the thumb, the bones of the first row are:

1. Scaphoid.
2. Semilunar.
3. Cuneiform.
4. Pisiform.

Those of the second row are:

5. Trapezium.
6. Trapezoid.
7. Os magnum.
8. Unciform.

They are called the **carpal** bones, and the wrist is called the carpus.

The radio-carpal, or wrist-joint, is formed by the articulation of the first three carpal bones, the scaphoid, semilunar and cuneiform, with the radius. The ulnar does not form part of the joint, a triangular fibro-cartilage being between its lower end and the carpal bones.

A fibrous membrane stretches across the space between the radius and ulna, which braces the bones together, and gives origin to some muscles. All the processes, tubercles and ridges on the bones are for the attachment of muscles. There is an intercarpal or transverse joint, formed by the articulation of the two rows of bones, which supplements the movements of the radio-carpal joint, and gives greater flexibility to the wrist. It is a gliding joint. Five **metacarpal** bones form the palm, the bases of which articulate with the second row of bones of the wrist and the heads with the bones of the fingers.

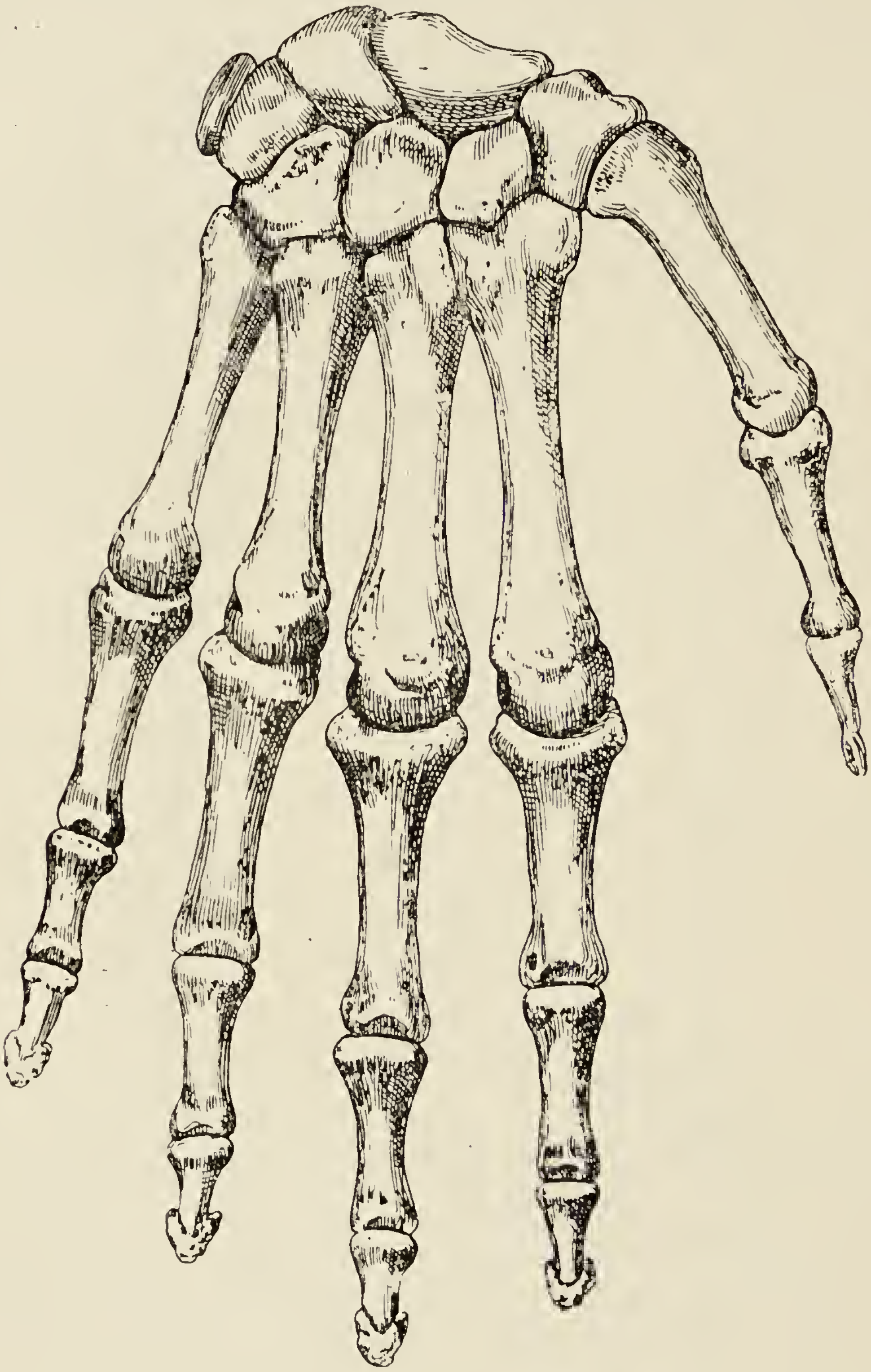

Fig. 35.—Back of Hand.

The metacarpal bone of the thumb is the first, and it articulates with the first bone—the trapezium; it is articulated in such a way that the thumb has very free movement. It can be moved in every direction. There are fourteen phalanges, three in each finger and two in the thumb. There are two sesamoid bones at the metacarpo-phalangeal joint of the thumb.

LIGAMENTS OF THE UPPER LIMB.

The acromio-clavicular ligament joins the acromion process to the clavicle.

The coraco-clavicular ligament joins the coracoid process to the clavicle.

The coraco-acromial ligament joins the coracoid process to the acromion process.

The ligaments of the **shoulder-joint** are:

1. Capsular.
2. Coraco-humeral.
3. Gleno-humeral.
4. Glenoid.

The capsular ligament envelops the joint, being attached to the margin of the glenoid cavity and ligament, and to the outer part of the anatomical neck of the humerus. The tendon of the long head of the biceps passes through an opening in it, at the top of the bicipital groove, to its attachment at the apex of the glenoid cavity. Synovial membrane lines the interior of the capsular ligament, and is reflected from it upon the head of the humerus.

The coraco-humeral ligament is a broad band attached to the coracoid process, and to the tuberosities of the humerus.

The gleno-humeral ligament is within the joint.

The glenoid ligament is the rim of fibro-cartilage which deepens the cavity.

The shoulder is a ball and socket joint, and is capable of the movements of:

(1) Flexion, forward movement;
(2) Extension, backward movement;
(3) Abduction, outward movement;
(4) Adduction, inward movement;
(5) Rotation, a movement of the bone on its own axis, in which it is not carried away from the body as in circumduction;
(6) Circumduction, which includes all the previous movements.

Between the acromion process and the capsule of the shoulder-joint there is a large bursa, the sub-acromial, by which the neighbouring surfaces are lubricated, and the movements of the upper end of the humerus facilitated.

Beside the two processes which overhang the head of the humerus, and the long tendon of biceps which crosses it, the joint is further strengthened and the bones kept in position by muscles from the back of the scapula, which also cross over and are inserted into the three facets of the greater tuberosity of the humerus. They are the supra-spinatus from above the spine of the scapula, inserted into the uppermost of the facets; the infra-spinatus from below the spine of the scapula inserted into the middle facet, and the teres minor from the axillary border of the scapula inserted into the lowest facet. The former supports the joint from *above*, the two latter from *behind*. In *front* is the subscapularis from the anterior of the scapula, which has insertion into the lesser tuberosity. Below, it receives partial support from the long head of the triceps, a muscle on the back of the arm inserted into the lower part of the glenoid cavity, and the teres major, coming from the inferior angle of the scapula to insertion into the inner ridge of the bicipital groove. It is important to bear in mind that this is the least supported part of the joint. Abduction of the arm should be very carefully performed in a case of previous downward dislocation. Atmospheric pressure also helps to keep the bones in position. The blood-supply of the joint is from the supra-scapular and posterior circumflex. The nerve-supply is the supra-scapular and circumflex.

The ligaments of the **elbow** are in the form of a capsule which surrounds the joint on all sides. They are the

(1) External lateral,
(2) Internal lateral,
(3) Anterior,
(4) Posterior.

The external lateral ligament is a short strong band attached to the lower part of the external condyle of the humerus, to the outer side of the olecranon process of the ulna and to the orbicular ligament of the radius.

The internal lateral ligament is attached to the internal condyle of the humerus, and to the coronoid and olecranon processes of the ulna. The anterior ligament is attached to the humerus above the coronoid fossa and to the coronoid process of the ulna and the orbicular ligament of the radius.

The posterior ligament is attached to the humerus above the olecranon fossa, to the olecranon process and the orbicular ligament.

Synovial membrane lines the capsule, and is reflected upon the bones which are enclosed within the ligaments. It lines the radial, coronoid, and olecranon fossa and goes down to the superior radio-ulnar joint. Movements of this joint are flexion and extension. A bursa intervenes between the tendon of biceps and tuberosity of radius.

The blood-supply of this joint is derived from the anastomosis of vessels surrounding the joint. The nerve supply is the ulnar, median and musculo-spiral.

The orbicular ligament mentioned before as surrounding the neck of the radius is the special ligament of the superior radio-ulnar joint. There is an anterior and posterior ligament passing from the radius to the ulna in connection with the inferior radio-ulnar joint. In this joint the synovial membrane forms a loose sac and extends some distance between the radius and ulna. In the superior radio-ulnar joint the synovial membrane continued from the elbow-joint lines the orbicular ligament. The movements of supination and pronation take place at the radio-ulnar joints. At the superior joint the head of the radius rotates within the orbicular ligament, moving on the capitellum of the humerus. At the inferior joint the lower end of the radius revolves round the lower end of the ulna. In supination the palm of the hand is upwards, the thumb outwards, and the two bones of the forearm parallel. In pronation the palm is downwards, the thumb inwards, and the radius lies across the ulna.

The ligaments of the **wrist** are the

(1) Anterior, (3) Internal,
(2) Posterior, (4) External.

They are attached to the lower end of the radius, and to the first row of carpal bones, and form a capsule round the joint, and are continuous with each other. Dorsal, palmar, and interosseous ligaments pass transversely between the individual bones of both rows, and also dorsal, palmar, lateral and interosseous ligaments pass from one row to the other. The movements of this joint are flexion, extension, abduction, adduction and circumduction.

Blood-supply, radial and ulnar arteries ; nerve-supply, ulnar nerve.

The four metacarpal bones are united by dorsal and palmar ligaments at their bases.

The transverse metacarpal ligament unites the heads of the metacarpal bones and prevents excessive separation from each other.

Synovial Membrane.—The pisiform, and the upper metacarpal joint of the thumb, have each a separate synovial membrane. The other carpal and metacarpal joints have a single synovial membrane.

The first row of joints formed by the heads of the metacarpal bones, and the first phalanx of the fingers, are ball and socket joints, and are capable of flexion, extension, abduction, adduction and circumduction. The second and third rows are simple hinge-joints, and are limited to flexion and extension.

These joints have each a palmar and two lateral ligaments, the deep surfaces of which are lined with synovial membrane.

MUSCLES.

The muscles chiefly concerned in producing movements of the joints of the upper limb are as follows :

Shoulder.

Flexion : pectoralis major, anterior fibres of deltoid.

Extension : latissimus dorsi, posterior fibres of deltoid, teres major.

Abduction : deltoid, supra-spinatus.

Adduction : pectoralis major, coraco-brachialis, teres major, latissimus dorsi.

Rotation, *inwards :* subscapularis, pectoralis major, latissimus dorsi, teres major.

Rotation, *outwards :* supra-spinatus, infra-spinatus, teres major.

Circumduction : combinations of these muscles.

Elbow.

Flexion: biceps, brachialis anticus, pronator radii teres, supinator longus.

Extension: triceps, anconeus.

Supination: biceps, supinator longus, supinator brevis.

Pronation: pronator radii teres, pronator quadratus, flexor carpi radialis.

Wrist.

Flexion: flexor carpi radialis, flexor carpi ulnaris, palmaris longus, flexor profundus digitorum, flexor longus pollicis.

Extension: extensor carpi radialis longus, extensor carpi radialis brevis, extensor carpi ulnaris.

Abduction: flexor carpi radialis.

Adduction: flexor carpi ulnaris.

Fingers.

The movements of the first phalanx are flexion, extension, abduction, adduction.

Flexion: interosseous and lumbrical muscles.

Extension: extensor communis and the special extensors of index and little fingers.

Abduction: dorsal interossei, abductor minimi digiti.

Adduction: palmar interossei.

Flexion of second phalanx is by flexor sublimis.

Flexion of third phalanx is by flexor profundus.

Extension of these joints is by interosseous and lumbricales and the extensor communis, into the tendons of which they are inserted.

There are twenty muscles to the forearm. They are divided into flexors, extensors, pronators and supinators.

The flexors and pronators consist of a deep and superficial layer, and pass down the front of the forearm.

The extensors and supinators are also divided into a deep and superficial layer, and pass down the back of the forearm.

The short muscles of the hand are all in the palm; four form the ball of the thumb, called the thenar eminence; three form the ball of the little finger, called the hypothenar eminence; one in the palm deepens the hollow when contracted, forming 'Diogenes' cup.'

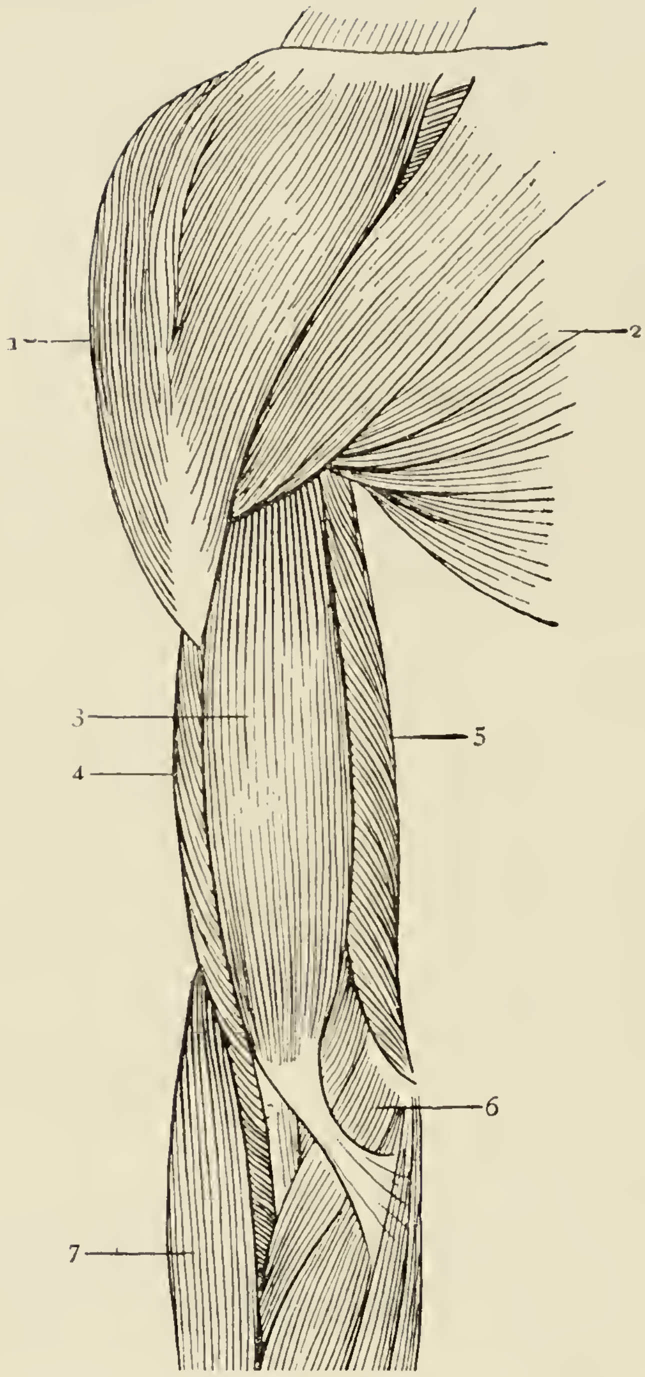

Fig. 36.—Superficial Muscles of Shoulder and Arm from Before.

1, Deltoid; 2, pectoralis major; 3, biceps; 4, brachialis anticus; 5, long head of triceps; 6, pronator radii teres; 7, supinator longus.

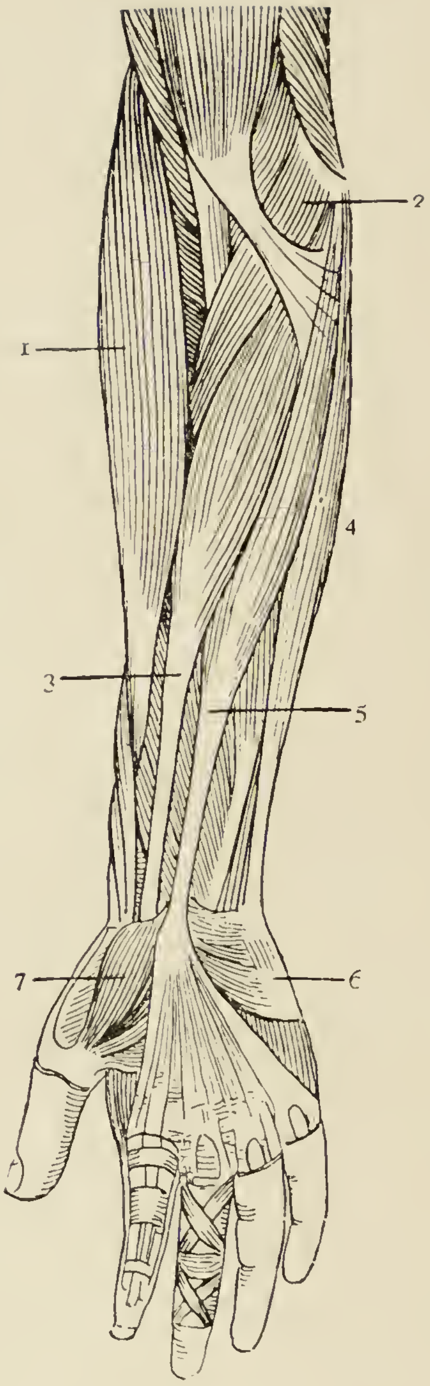

Fig. 37.—Superficial Muscle of Front of Forearm and Hand.

1, Supinator longus; 2, pronator radii teres; 3, flexor carpi radialis; 4, flexor carpi ulnaris; 5, palmaris brevis; adductor pollicis.

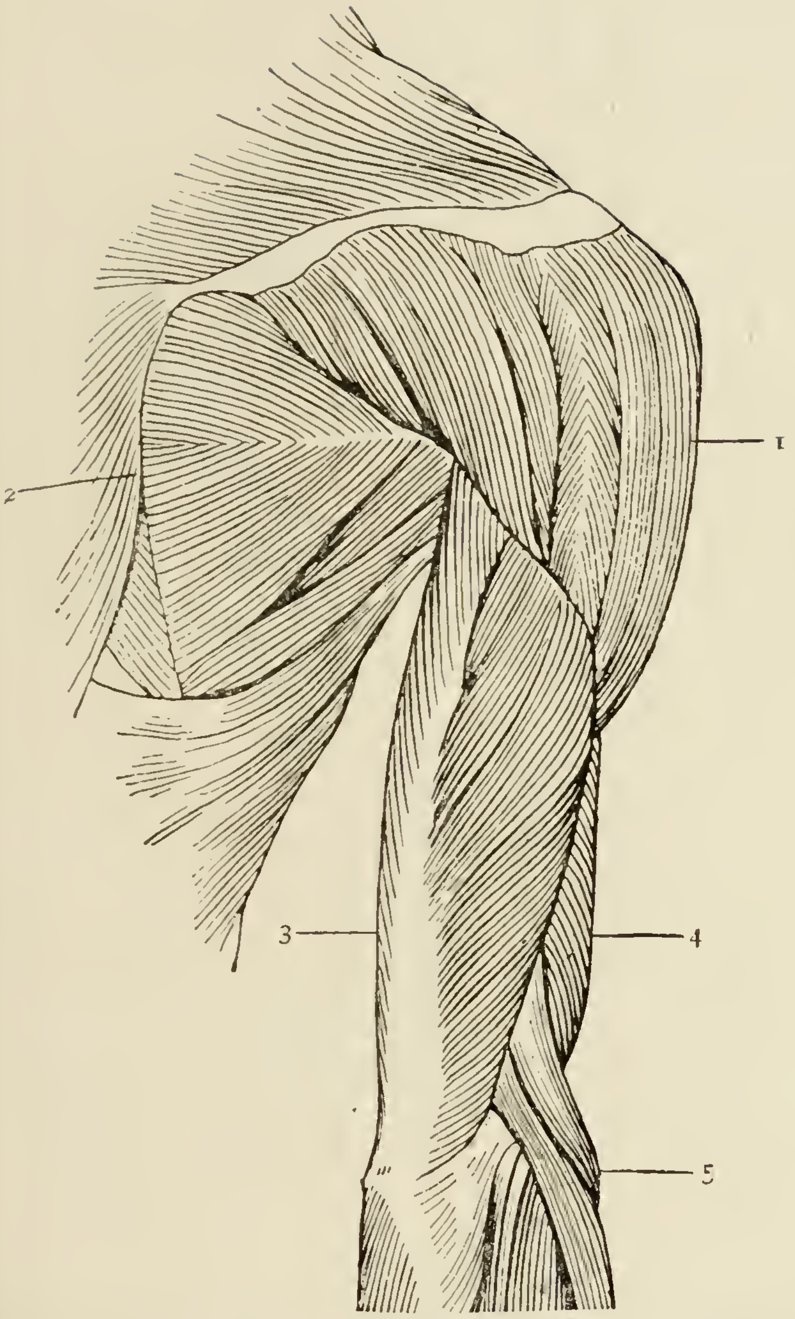

FIG. 38.—SUPERFICIAL MUSCLES OF SHOULDER AND ARM FROM BEHIND.

1, Deltoid; 2, infra-spinatus: 3, triceps; 4, brachialis anticus; 5, supinator longus.

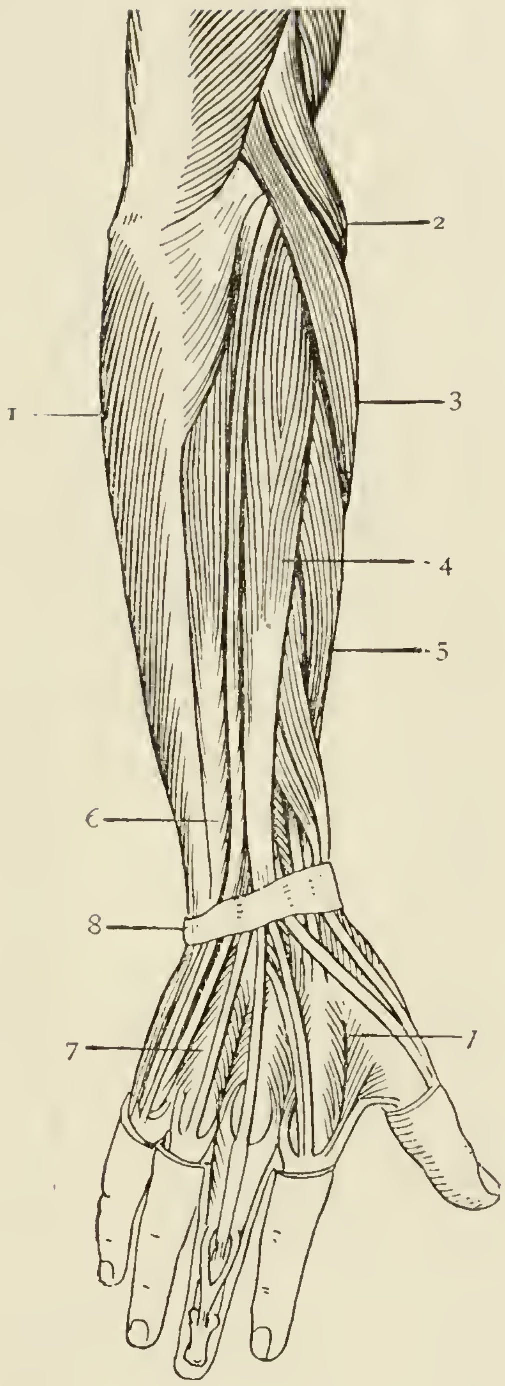

FIG. 39.—SUPERFICIAL MUSCLES OF BACK OF FOREARM AND HAND.

1, Flexor carpi ulnaris; 2, supinator longus; 3, ext. carpi radialis longus; 4, ext. communis digitorum; 5, ext. carpi radialis brevis; 6, ext. carpi ulnaris; 7, dorsal interosseous; 8, posterior annular ligament.

TABLE OF MUSCLES OF UPPER LIMB.

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Latissimus dorsi.	Crest of ilium, sacral, lumbar, and six lower dorsal spines, lower angle scapula, supra-spinous ligament.	Lower part inner ridge bicipital groove of humerus	Draws elevated arm back and obliquely down, raises body to arms.	Long subscapularis.
Pectoralis major.	Sternum, clavicle, seven upper costal cartilages.	Outer ridge bicipital groove of humerus.	Draws arm forwards and upward, raises body to arms.	External anterior thoracic.
Supra-spinatus.	Fossa above spine of scapula.	Great tuberosity of humerus (upper facet).	Assists middle fibres of deltoid in raising arm.	Supra-scapular.
Infra-spinatus.	Fossa below spine of scapula.	Great tuberosity of humerus (middle facet).	Rotates humerus outwards.	Supra-scapular.
Teres minor.	Axillary border of scapula.	Great tuberosity of humerus (lower facet).	Rotates humerus outwards.	Circumflex.
Teres major.	Inferior angle of scapula.	Inner ridge of bicipital groove.	Assists latissimus dorsi in drawing humerus down and back.	Subscapular.
Subscapularis.	Anterior aspect of scapula.	Lesser tuberosity of humerus.	Rotates humerus inwards.	Subscapular.

Deltoid.	Outer third of clavicle. Outer edge acromion process. Lower border spine of scapula.	Deltoid impression on outer side of shaft of humerus.	Raises arm by middle fibres. Draws it back by posterior fibres and forward by anterior fibres.	Circumflex.
Coraco-brachialis.	Coracoid process of scapula.	Inner side of shaft of humerus, about the middle.	Raises arm obliquely and draws it to the side.	Musculo-cutaneous.
Biceps, two heads.	(1) Apex glenoid cavity. (2) Coracoid process of scapula.	Tuberosity of radius.	Flexes and supinates forearm.	Musculo-cutaneous.
Brachialis anticus.	By forked head each side of deltoid and lower half shaft of humerus.	Coronoid process of ulnar.	Flexes forearm.	Musculo-cutaneous. Musculo-spiral.
Triceps, three heads.	(1) Lower part glenoid cavity. (2) Middle of humerus above musculo-spiral groove. (3) Below musculo-spiral groove.	Olecranon process of ulnar.	Extends forearm.	Musculo-spiral.
Anconeus.	Back of external condyle of humerus.	Olecranon process and upper part of shaft of ulnar.	Assists triceps to extend forearm.	Musculo-spiral.
Pronator radii teres.	Inner condyle of humerus. Coronoid process of ulna.	Middle of outer surface of radius.	Pronates hand.	Median.

TABLE OF MUSCLES OF UPPER LIMB—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Flexor carpi radialis.	Inner condyle of humerus.	Palmar surface, first and second metacarpal bones.	Flexes wrist. Draws hand to radial side.	Median.
Palmaris longus.	Inner condyle of humerus. Fascia of forearm.	Annular ligament. Palmar fascia.	Flexes wrist. Makes tense palmar fascia.	Median.
Flexor carpi ulnaris.	Inner condyle of humerus. Inner side of olecranon. Back of ulna.	Pisiform and unciform bones. Fifth metacarpal bone.	Flexes hands. Draws hands to ulnar side.	Ulnar.
Flexor sublimus digitorum.	Inner condyle of humerus. Internal lateral ligament of elbow. Anterior border of radius.	By four tendons into second phalanges.	Flexes fingers from second phalanx, also flexes wrist and elbow.	Median.
Flexor profundus digitorum.	Upper three-fourths of shaft of ulna.	By four tendons into third phalanges.	Same as sublimus, but goes further.	Ulnar. Anterior interosseous.
Lumbricales.	In palm from tendons of profundus.	Into extensor tendon at radial side of fingers.	Assist in quick, short movements. Flex first phalanx, extend others.	Median. Ulnar.

Flexor longus pollicis.	Shaft of radius.	Last phalanx of thumb.	Flexes thumb.	Anterior interosseous.
Pronator quadratus.	Lower fourth of ulna to about 2 inches above wrist.	Lower fourth of radius.	Pronates hand.	Anterior interosseous.
Supinator longus.	Ridge above external condyle of humerus.	Close to styloid process of radius.	Supinates forearm.	Musculo-spiral.
Extensor carpi radialis longior.	Ridge above external condyle of humerus.	Base of metacarpal bone of index finger.	Extends wrist. Flexes elbow.	Musculo-spiral.
Extensor carpi radialis brevior.	External condyle of humerus.	Base of third metacarpal bone.	Extends wrist. Flexes elbow.	Posterior interosseous.
Extensor communis digitorum.	External condyle of humerus.	Back of last two phalanges of four inner fingers.	Extends fingers.	Posterior interosseous.
Extensor minimi digiti.	External condyle of humerus.	Back of first phalanx of little finger.	Extends little finger.	Posterior interosseous.
Extensor carpi ulnaris.	External condyle of humerus.	Base of metacarpal bone of little finger at back.	Extends wrist.	Posterior interosseous.

TABLE OF MUSCLES OF UPPER LIMB—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Supinator radii brevis.	Depression below lesser sigmoid cavity. External and orbicularis ligaments of elbow.	Upper third of radius.	Supinates hand.	Posterior interosseous.
Extensor ossis metacarpi pollicis.	Posterior surface of middle of radius and ulna.	Radial side of base of first metacarpal.	Extends and abducts thumb.	Posterior interosseous.
Extensor primi internodii pollicis.	Radius below last muscle.	Base of first phalanx of thumb at back.	Extends and abducts thumb.	Posterior interosseous.
Extensor secundi internodii pollicis.	Middle of ulna. Interosseous membrane.	Base of first phalanx of thumb at back.	Extends and abducts thumb.	Posterior interosseous.
Extensor indicis proprius.	Middle of ulna. Interosseous membrane.	Back of first phalanx of index-finger.	Points index finger.	Posterior interosseous.
Abductor pollicis.	Annular ligament. Trapezium.	Base of first phalanx of thumb, outer side.	Draws thumb from fingers.	Median.

Opponens pollicis.	Annular ligament. Trapezium.	Whole length first metacarpal.	Flexes thumb and draws it across fingers.	Median.
Flexor brevis pollicis.	Annular ligament. Second row carpal bones.	Outer side base first phalanx.	Flexes thumb and draws it across fingers.	Median.
Adductor pollicis.	Bases of second and third metacarpal. First three carpal bones, second row.	Inner side first phalanx thumb.	Draws thumb to fingers, as in pinching.	Ulnar—deep branch.
Abductor minimum digiti.	Pisiform. Fifth metacarpal.	Ulnar side first phalange little finger.	Draws finger out.	Ulnar—deep branch.
Flexor brevis minimi digiti.	Annular ligament. Unciform bone.	Ulnar side first phalange little finger.	Flexes little finger.	Ulnar—deep branch.
Opponens minimi digiti.	Annular ligament. Unciform bone.	Whole surface metacarpal bone.	Flexes little finger. Helps to deepen palm.	Ulnar—deep branch.
Dorsal interossei.	Sides of metacarpal bones.	Bases of phalanges.	Separate fingers ; draw out from line drawn through middle finger.	Ulnar—deep branch.
Palmar interossei.	Palmar sides of metacarpal bones.	Bases of phalanges.	Adducts fingers from line drawn through middle finger.	Ulnar—deep branch.

FASCIA.

The deep fascia which binds together the muscles of the shoulder is very strong and tendinous.

The deep fascia of the arm is thin over the biceps and dense over the triceps and condyles; to the latter it is fixed. On the forearm it is strong and dense, particularly on the back and lower part; on the back of the hand it is thin, while in the palm it is dense and serves as a protection to the nerves, blood-vessels and tendons.

The superficial fascia is the tissue which lies directly over the deep fascia and immediately under the skin.

The *annular* ligament is a thickened band of the deep fascia which invests the forearm.

The *anterior* annular ligament on the front of the wrist is attached to the scaphoid and trapezium externally, and to the unciform and pisiform bones internally.

The *posterior* annular ligament on the back of the wrist is attached to the radius externally, and to the cuneiform and pisiform bones internally.

The extensor tendons of the muscles of the back of the forearm that have insertions into the fingers and metacarpal bones pass under the posterior annular ligament. There are six compartments for these tendons; each compartment is lined by a synovial sheath.

The flexor tendons in the front of the forearm pass under the anterior annular ligament, and have two sheaths. One invests the tendon of the longest pollicis, the other invests the tendons of the sublimus and profundus muscles.

BLOODVESSELS OF UPPER LIMB.

Arteries.

The **right subclavian artery** arises from the bifurcation of the innominate artery.

The **left subclavian artery** arises from the arch of the aorta. In both cases the artery arches outwards across the root of the neck and is the beginning of the main artery of the upper limb.

At the outer border of the first rib it enters the axilla, or armpit, and receives the name of the axillary artery. The axillary artery is the direct continuation of the subclavian. It passes through the axilla to the lower border of the teres major muscle.

The **brachial artery** is a continuation of the axillary, and reaches to just below the bend of the elbow, where it divides into the ulnar and radial.

The **ulnar artery** is the larger of the two. It runs down the inner side of the forearm, and ends in the superficial palmar arch, where it is joined by a branch from the radial.

The **radial artery** extends along the front of the forearm as far as the end of the radius, where it turns round the outer border of the wrist, and passes between the thumb and the index-finger into the palm of the hand, where it forms the deep palmar arch.

The superficial and deep palmar arches supply the hand with blood.

Numerous branches are sent off from these arteries to supply neighbouring muscles.

Veins.

The deep veins accompany their respective arteries, and are called by their names. The superficial are the following: the radial veins on the outer border; the anterior and posterior ulnar on the inner border; and the median vein on the front of the forearm.

The median vein begins in the thumb, passes up the middle of the forearm to the bend of the elbow, where it is joined by the profunda vein, which conducts it to the deep veins of the forearm. The median then divides into an inner branch, the median basilic, and an outer branch, the median cephalic.

The radial vein begins in the dorsal aspect of the first interosseous space, and passes up the outer side of the forearm, turning forwards at the elbow-joint to join the median cephalic, and form the cephalic vein.

The cephalic vein passes up the outer side of the biceps

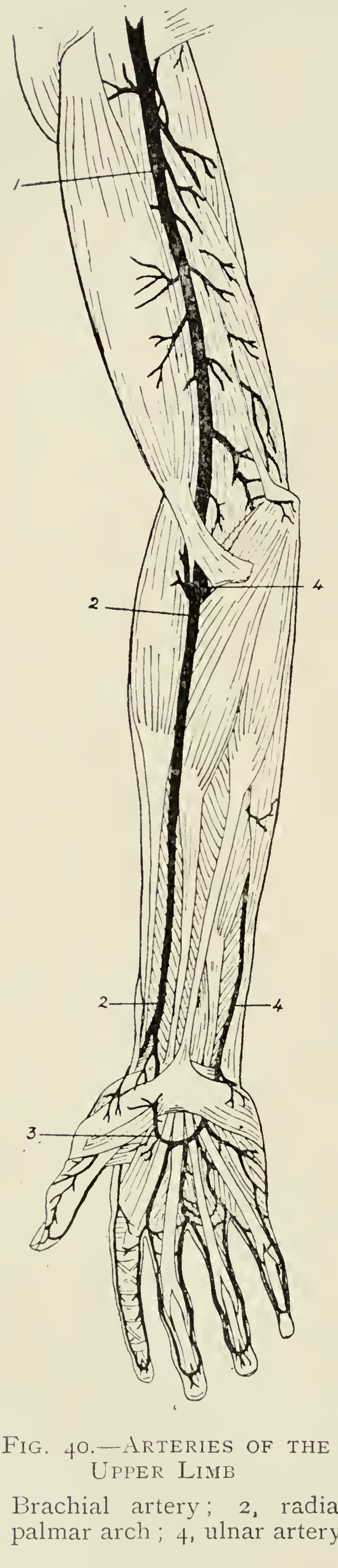

Fig. 40.—Arteries of the Upper Limb

1, Brachial artery; 2, radial; 3, palmar arch; 4, ulnar artery.

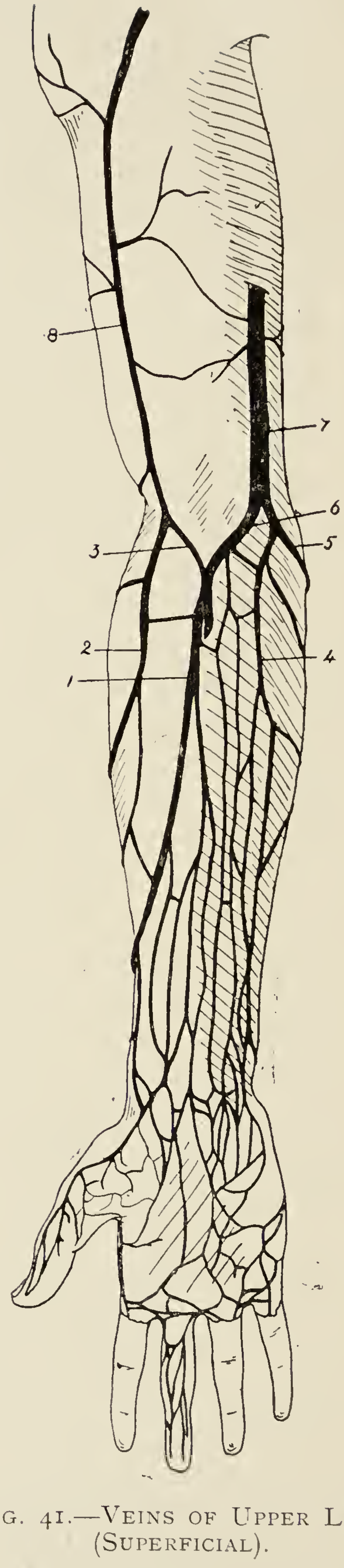

Fig. 41.—Veins of Upper Limb (Superficial).

1, Median vein; 2, radial; 3, median cephalic; 4, anterior ulnar; 5, posterior ulna; 6, median basilic; 7, basilic; 8, cephalic.

muscle, piercing the fascia at the insertion of the deltoid muscle and finally opening into the axillary vein.

The anterior ulnar vein begins in the ball of the little finger, and ascends the anterior surface of the ulnar border of the forearm.

The posterior ulnar begins on the back of the hand in the fourth interosseous space, and proceeds up the posterior aspect of the ulnar border of the forearm and joins the anterior ulnar vein to form the basilic vein.

The basilic vein passes up on the inner side of the upper arm, receives the median basilic, and pierces the fascia to join the deep veins. At the lower border of the posterior wall of the armpit it forms the axillary vein.

The axillary vein which collects all the blood returning from the arm accompanies the axillary artery to the outer border of the first rib, where it is continuous with the subclavian vein.

The subclavian vein extends from the outer margin of the first rib to the inner end of the clavicle, where it joins the internal jugular to form the innominate vein.

The right and left innominate veins unite behind the first right costal cartilage at its junction with the sternum, and form the superior vena cava, which carries the blood from the head, arms, and all veins above the heart to the upper part of the right auricle. It is 3 inches long. It has no valve; the weight of the blood renders one unnecessary.

LYMPHATICS.

The superficial lymphatics of the upper limb begin in the fingers; two lymphatic vessels ascend from the palmar surface of each finger and form an arch in the palm. Two ascend from the back of each finger, and form a network on the dorsum of the hand. They pass up and thickly cover the forearm and arm, and proceed to the axillary glands.

The deep lymphatics correspond to the deep bloodvessels in their course up the forearm and arm. They also terminate in the axillary glands. The superficial and deep set of lymphatics communicate with each other.

There are ten or twelve lymphatic glands in the axilla, disposed in three groups; those that receive the ascending lymphatics lie close to the axillary vessels; those that receive the lymphatics from the chest lie along the border of the pectoralis minor muscle; those that receive the lymphatics from the back lie along the lower border of the subscapularis muscle.

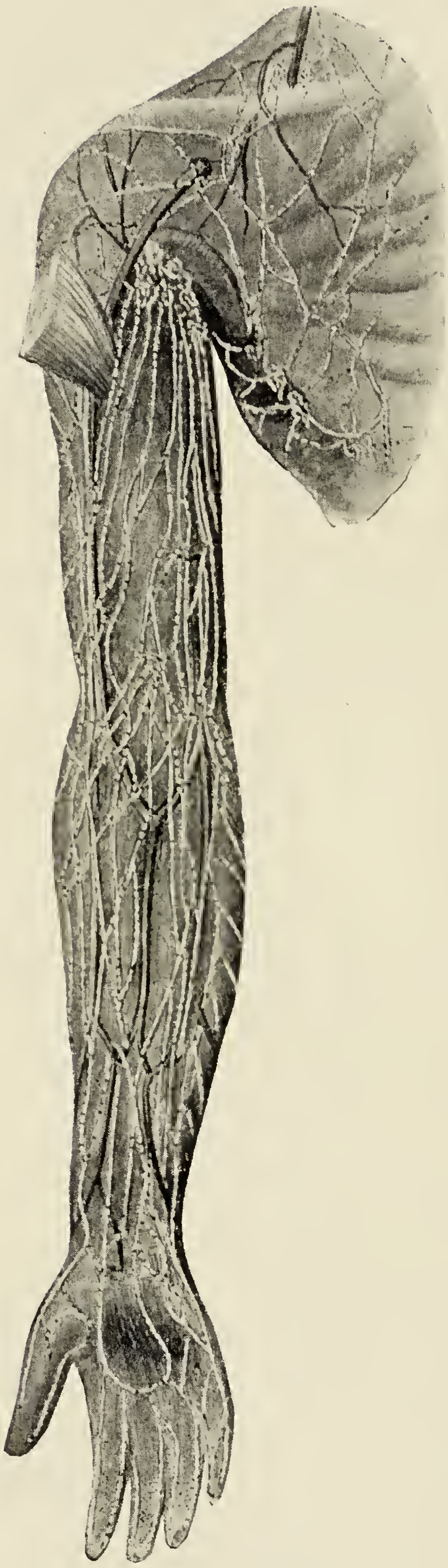

FIG. 42.—LYMPHATICS OF UPPER LIMB.

CHIEF NERVES OF THE UPPER LIMB.

The upper limb is supplied by nerves from the **brachial plexus.** Above the clavicle the fifth, sixth and seventh nerves send branches to adjacent muscles. The suprascapular is the largest branch given off above the clavicle.

Below the clavicle the three cords give off branches. The three sub-scapulars, the circumflex and musculo-spiral nerves arise from the posterior cord.

The **musculo-spiral** is the largest branch of the plexus. It passes under the axillary artery, and between the inner and outer heads of the triceps muscle, reaches the musculo-spiral groove, winds through it to the outer side of the arm, where it divides into the radial and posterior interosseus, which go down the back of the forearm and hand.

The external anterior thoracic, musculo-cutaneous and outer head of median arise from the outer cord.

The **musculo-cutaneous** passes down between the biceps and brachialis anticus to the elbow, where it divides into anterior and posterior branches.

The internal anterior thoracic, internal cutaneous, ulnar, and inner head of median arise from the inner cord.

The **ulnar** is the largest branch of the inner cord ; it passes along the inner side of the arm till it reaches the space between the internal condyle and the olecranon, when it enters the forearm and goes straight to the wrist and hand.

The **median** arises from inner and outer cords. It passes down the inside of the arm to the elbow, and enters the forearm between the two heads of the pronator radii teres. It proceeds down the middle of the forearm and terminates in the hand.

In emerging from the axilla the cords accompany the artery.

MASSAGE OF THE UPPER LIMB.

Hand.—The operator should stand or sit facing the patient, whose arm must be supported, if sitting, with the elbow on a table ; if in bed, with the elbow resting on the bed. The arm must not be raised nor pulled out from the shoulder, as it would be fatiguing to the patient.

1. To effleurage the fingers, each one is taken separately between the thumb and index-finger, held transversely to it and stroked from the nail upwards several times on the front and back and on the sides.

2. A pressure movement is then made by clasping the finger in the hand several times, or with the thumb and index-finger several small pressures may be given along the length of the finger.

3. To get at the very ends, each tip may be stroked firmly and rapidly towards the nail ; or held on a plane, they may be rubbed quickly with the palm of the hand.

4. In cases of rheumatism or stiff joints from any cause, special movements for the joints must be added to the above. They are, friction of each joint separately with the thumb ; under, over, at the sides, every part well manipulated, also every

joint gone over with an upward pushing movement with the thumb, the whole finger to be stroked at the finish.

5. Each joint is to be flexed and extended; circumduction to be added to the first joint.

6. **Back of Hand.**—Friction with the thumb between each two metacarpal bones from the fingers to the wrist, several circles to be made each time before proceeding onward; followed by effleurage with the thumb over some spaces.

7. **Palm.**—With the palm turned upwards, the balls of the little finger and thumb are kneaded with the thumb and index-finger, then an upward pushing movement with both thumbs in the hollow between. In matting of tissues or scars after palmar abscess or accidents, friction with the thumb is added, and the tissues are well stretched by being drawn from the middle line with both hands. Another way of doing the palm is to interlock the thumb with the patient's thumb, palm against palm, the fingers fixed at the back of the hand; the palm is kneaded by a firm backward and forward movement of the operator's hand. The right hand is used for the right hand, and the left for the left. Support must be given at the back of the patient's hand.

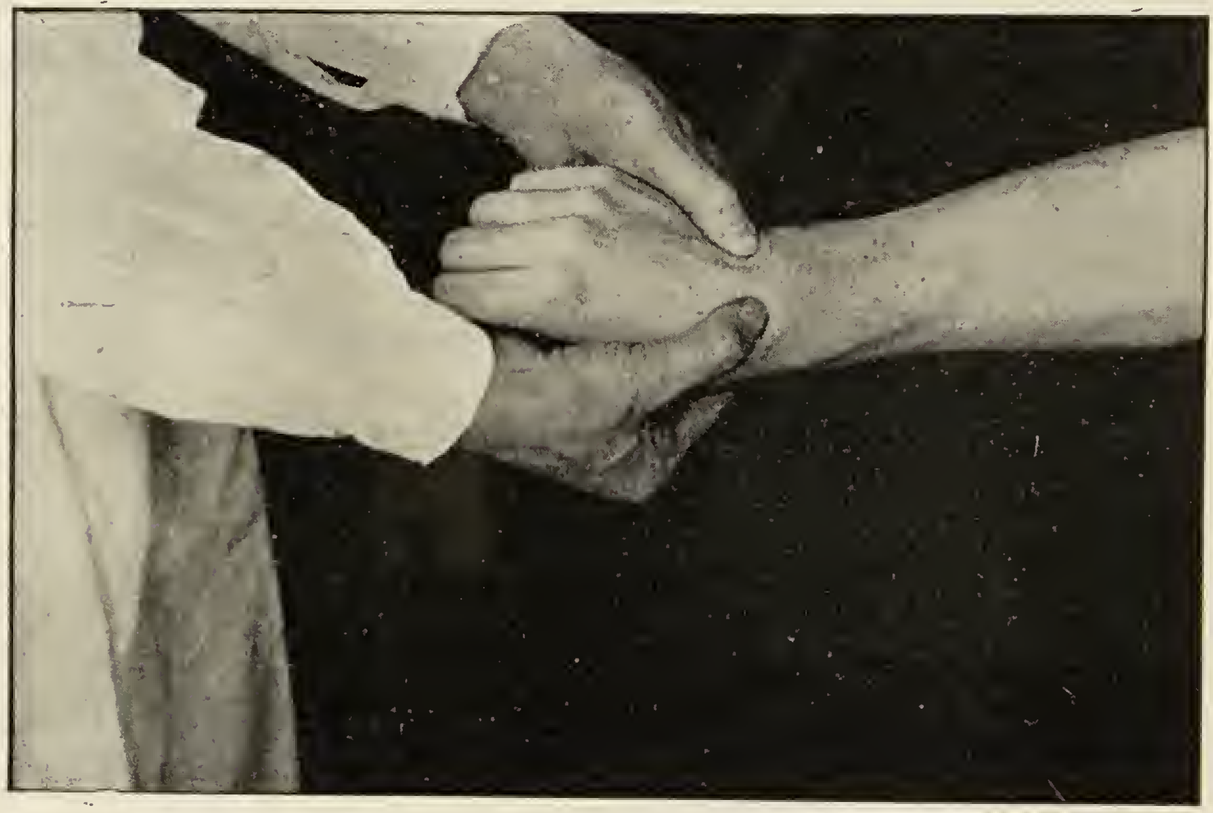

FIG. 43.—FRICTION OF WRIST.

8. The hand is taken between the two hands lengthwise, and rapid to-and-fro movements made alternately on the back and the palm (fulling) from the tips of the fingers to the wrist.

9. **Wrist.**—Friction with the thumb in all depressions between the carpal bones, followed by effleurage with the tips of the fingers and a circular movement with the balls of the thumbs.

Later on joints will be more fully treated of in regard to sprains, etc.

10. Passive movements.

The arm is grasped above the wrist; the hand is grasped at the palm. Care must be taken not to hinder circulation by too firm a grasp, and to avoid making pressure on the edges of the bones.

Flexion, the hand is bent toward the forearm, Extension, the hand is straightened. If bent backwards, it is over-extension; abduction, it is carried to the thumb side; adduction, it is carried to the little-finger side. Circumduction is a combination of all these movements.

Active movements are done in the same way, but by the patient alone.

Resistive movements are done in the same way, but resistance is given.

In healthy joints the passive movement is continued till resistance is felt—that is, to the limit of the natural movement of the joint. In stiff joints resistance may be met at the outset; then patience, gentleness and tact are needed, so as not to unnecessarily hurt or frighten the patient, especially if a child, as some force must be used. Where the muscles are wasted, they should be improved and strengthened by massage for some days before movements are tried. Massage should always precede the movements, and also be resorted to in between.

In joints with lax ligaments care must be taken not to exceed the natural limit of movement.

When the movement of a joint causes pain, patients frequently make conscious or unconscious resistance, thereby increasing the difficulty of movement and the pain. It is well in such cases to desist for the moment, and to engage the patient in conversation before a second attempt, so as to distract attention from the joint. Even when sincerely wishing to relax their muscles, patients have frequently much difficulty in not contracting them. The limb should be held so that only one joint is between the operator's hands.

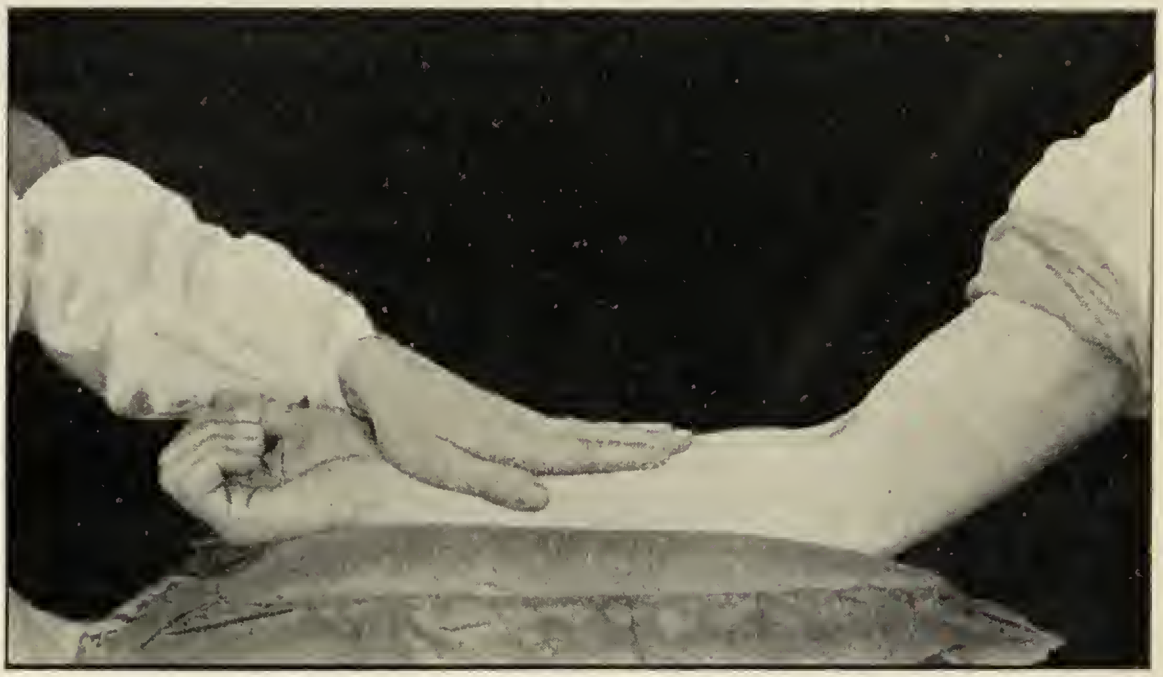

FIG. 44.—EFFLEURAGE WITH FLAT HAND.

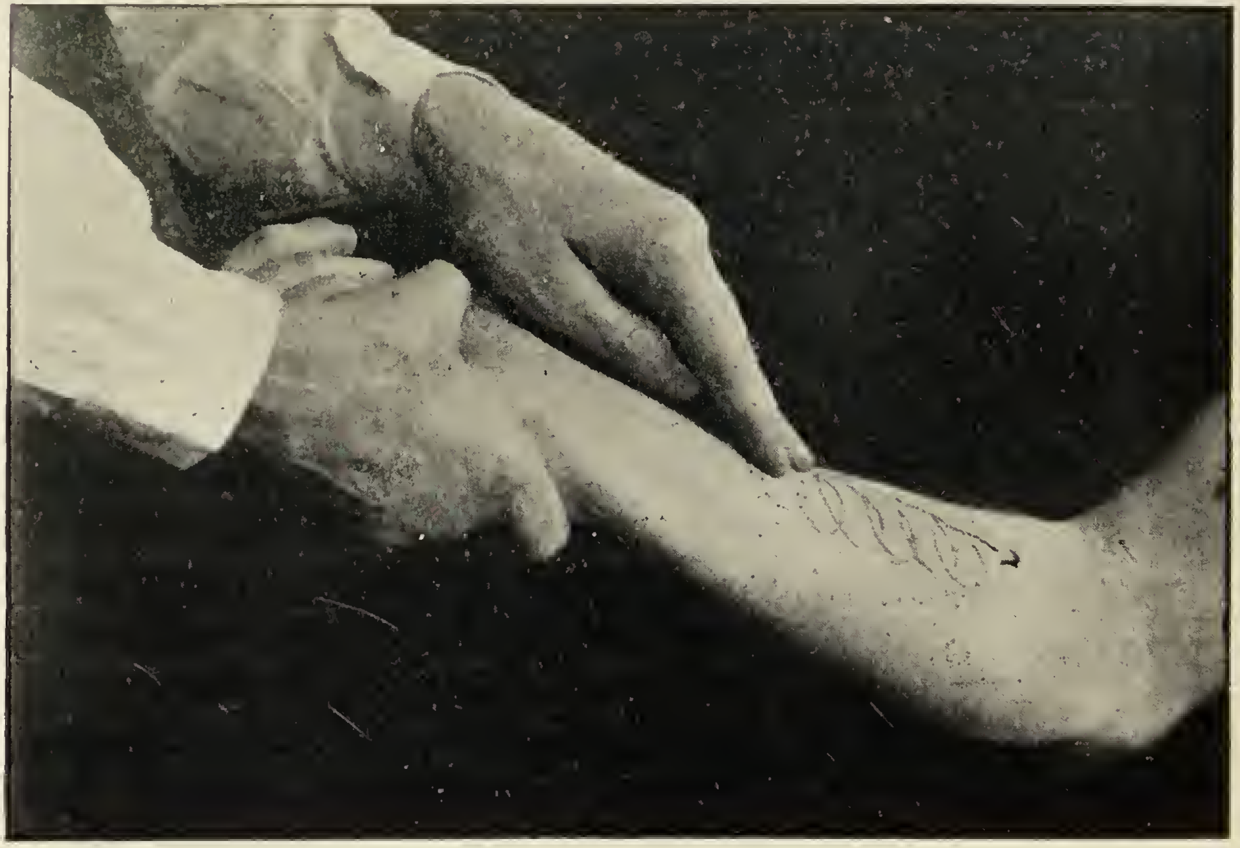

FIG. 45.—CIRCULAR EFFLEURAGE.

The Forearm—1. **Effleurage.**—The forearm, somewhat flexed to relax the muscles, rests on and is supported by one hand, while the other makes straight, even, rapid strokes with the whole palmar surface from wrist to elbow; without losing contact it glides back after each stroke. Twenty or more strokes may be made on the front of the arm, the same on the side next the hand that is working, the same on the other side and the back, the other hand being used. Thus the forearm is stroked in four divisions; the hands must be fitted into the shape of the parts worked on. No break is made in the work in passing from one division to the other.

2. **Pétrissage.**—With the heel of the hand work from the wrist to the elbow, on the flexors and pronators on one side, and the extensors and supinators on the other.

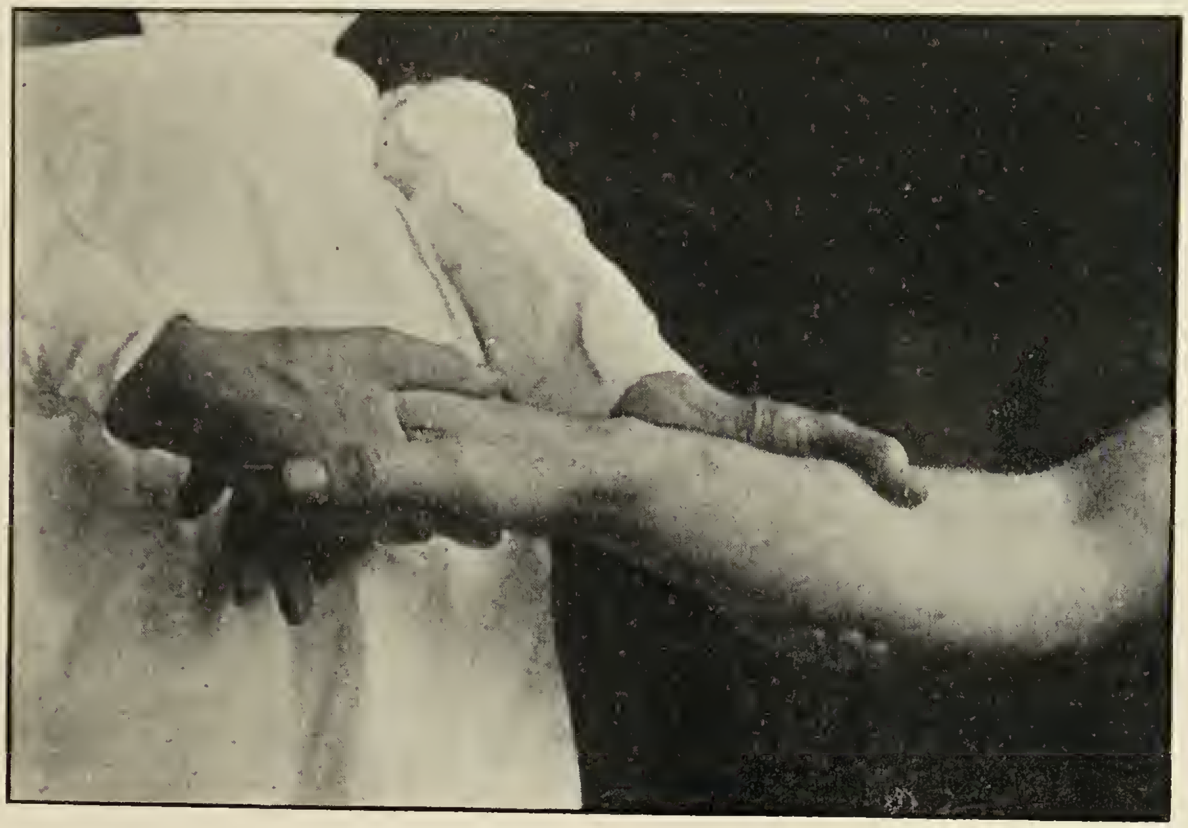

FIG. 46.—EFFLEURAGE WITH THUMB AND FINGERS.

3. With both hands grasping the same groups of muscles, deep kneading with the palms. Between each deep movement stroking should be done.

4. **Fulling** from wrist to elbow.

5. **Squeezing** from wrist to elbow.

Elbow.—1. Effleurage all over the joint.
2. Friction into all depressions.
3. Pétrissage with the heel of the hand.
4. Effleurage.

Passive Movements.—To flex, the arm is grasped above the elbow and the forearm above the wrist, and the forearm is brought up to the arm. To extend, the arm is straightened. To supinate and pronate, the elbow is grasped with the thumb in front, that the joint may be controlled. The hand is taken as in shaking hands; the palm is turned upwards and then downwards.

The Arm—1.—The inner side is stroked with the open hand, the thumb separated from the fingers. The outer side in the same way. Then, with flat hand, from the point of the elbow to over the shoulder-joint.

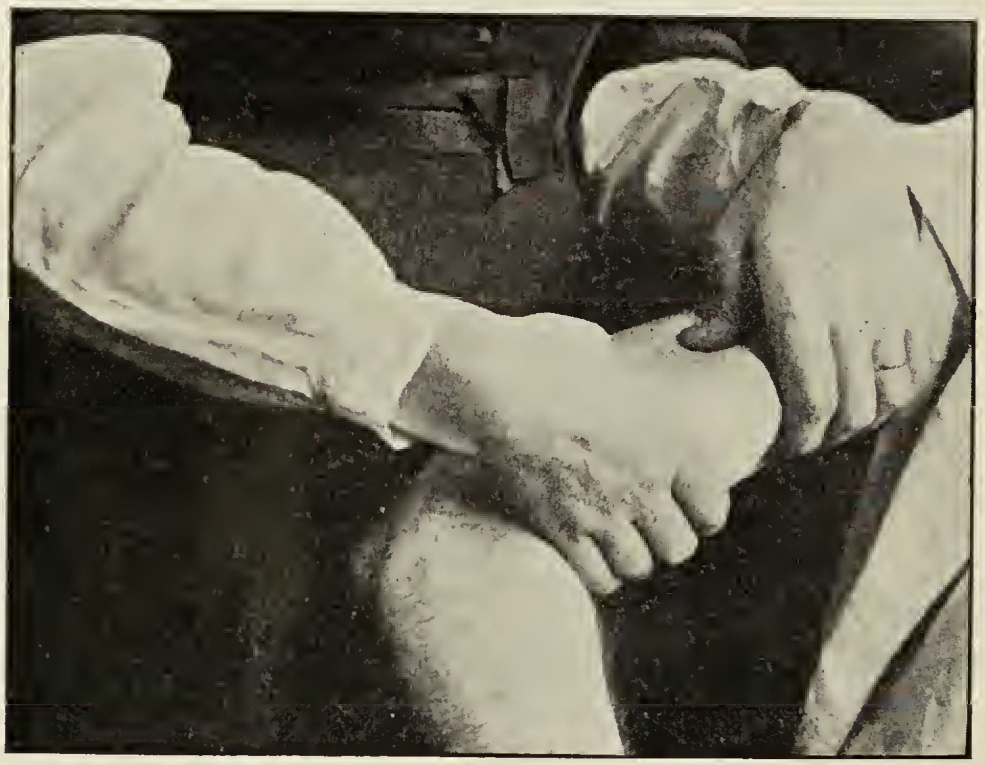

Fig. 47.—Pétrissage with Fingers and Thumbs.

2. The biceps, brachialis anticus, to be taken up between the thumbs and fingers and kneaded. The triceps, ditto; deltoid, ditto; the latter is also kneaded with the heel of the hand, the muscle fibres being followed to their various origins.

3. Deep kneading with both hands, one working on biceps, the other on triceps, stroking between the movements.

4. **Fulling** from elbow to shoulder.

5. **Squeezing** from elbow to shoulder.

6. The whole limb from shoulder to wrist slapped with flat fingers and with flail movement.

7. Rolling effleurage from wrist to shoulder.

Shoulder—1.—Friction with three fingers round the top of the humerus, beginning well in the armpit in front and finishing well in the armpit at the back.

2. The palm, cupped or hollowed, is placed on the 'point' of the shoulder, and the tissues moved about.

3. Effleurage over and round joint.

4. The pectoral muscle is kneaded from the sternum to the humerus with the ends of the fingers, followed by effleurage.

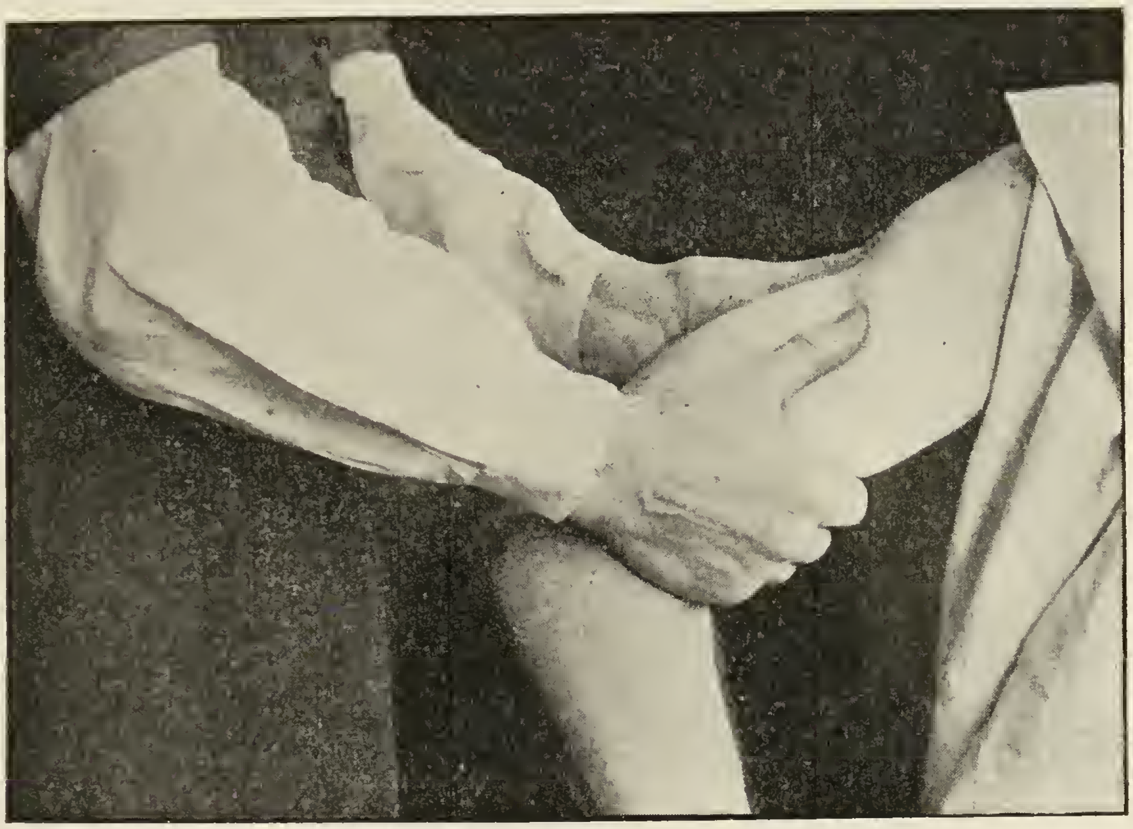

FIG. 48.—PÉTRISSAGE WITH PALMS.

5. The muscles of the scapula are kneaded with the heel of the hand from the vertebral border to the point of the shoulder; effleurage over the same region.

6. The scapula is outlined with the ulnar border of the hand with a sawing movement backward and forward.

Where there is wasting, attention must be given to the folds of the axilla; the fingers, covered with lint or a towel, should be worked well into the armpit, and the folds worked between the thumb and fingers.

It is not necessary to use all the above manipulations to a limb at one séance; those are chosen which are the most suitable to any given case.

Sufficient time must be given to each movement that is used to make it effective.

Extra kneading must be given to any wasted muscle or muscles.

Passive Movements.—Rotation, the arm is grasped about the middle, the forearm above the wrist; the hand on the arm makes a twisting movement, forwards and backwards, which turns the head of the humerus in the socket.

Another way of doing this movement is to fix the scapula with one hand and to make the elbow describe a circle, with the other hand grasping the forearm.

Circumduction: the arm is carried forward, upward, outward, downward.

Elevation: the arm is raised to the side of the head.

Depression: it is brought down to the side of the body.

Abduction: it is carried away from the body.

Adduction: it is carried inwards beyond the middle line.

CHAPTER VI

THE LOWER LIMB

BONES.

Innominate,	or	Hip-bone.
Femur,	,,	Thigh-bone.
Patella,	,,	Kneecap.
Tibia,	,,	Shin-bone.
Fibula,	,,	Splint-bone.
Tarsal,	,,	Bones of foot.
Metatarsal	,,	
Phalanges	,,	Bones of toes.

The **innominate bone** forms part of the pelvis. In early life it consists of three parts:

(1) **Ilium,**
(2) **Ischium,**
(3) **Pubis.**

The junction of these three bones forms a cup-like cavity called the cotyloid cavity, or acetabulum, which receives the superior head of the femur and forms the hip-joint. The cavity is deeper than that of the shoulder, and is further deepened by a rim of fibro-cartilage, called the cotyloid ligament. The round head of the femur is more prominent than that of the humerus; for these reasons the hip-joint is not so freely movable as the shoulder-joint.

The **femur** is a long, cylindrical bone, the longest and strongest in the skeleton. It consists of a superior and inferior head and shaft. The neck connects the superior head with the shaft; below the neck are two protuberances, the greater and lesser trochanters, which give attachment to muscles.

Down the back of the shaft there is a rough line running down called the linea aspera, to which muscles are also attached. The inferior head is flattened ; it has two tuberosities and two projections, called condyles, internal and external. There is a deep notch between called the intercondyloid notch. Several muscles of the leg are attached to the condyles of the femur.

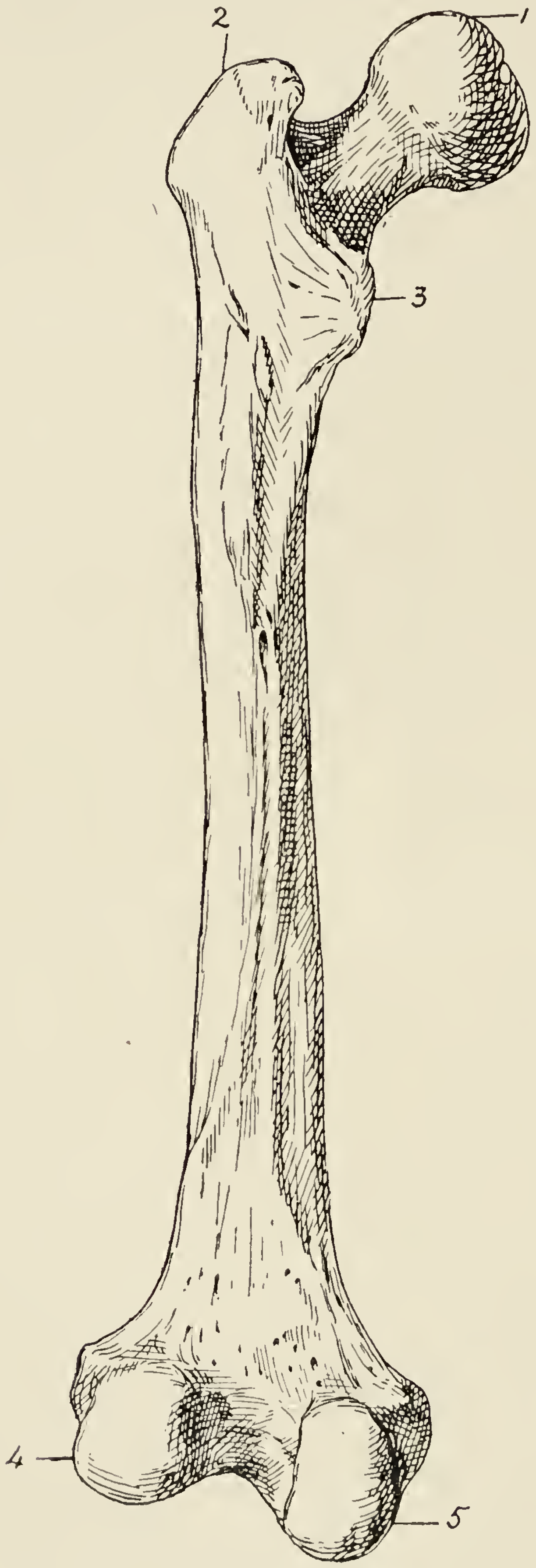

FIG. 49.—THE FEMUR.

1, Head ; 2, great trochanter ; 3, less trochanter ; 4, external condyle ; 5, internal condyle.

The Leg.

The bones of the leg are the **tibia** and **fibula** ; the tibia is the inner and larger bone, and articulates at its upper extremity by two tuberosities with the condyles of the femur to form the knee-joint. There is a facet on the external tuberosity for articulation with the head of the fibula. In front, below the head, there is a prominence called the anterior tubercle, to which the ligamentum patella is attached. Down the front of the shaft is a sharp edge called the crest of the tibia. The thick process at the lower extremity is the inner malleolus, which articulates with the astragalus and forms the inner ankle.

The **fibula** is parallel with the tibia on its outer side, and articulates with it at both extremities. It does not enter into the formation of the knee-joint; at its upper end there is a projection called the styloid process. The shaft is very slender,

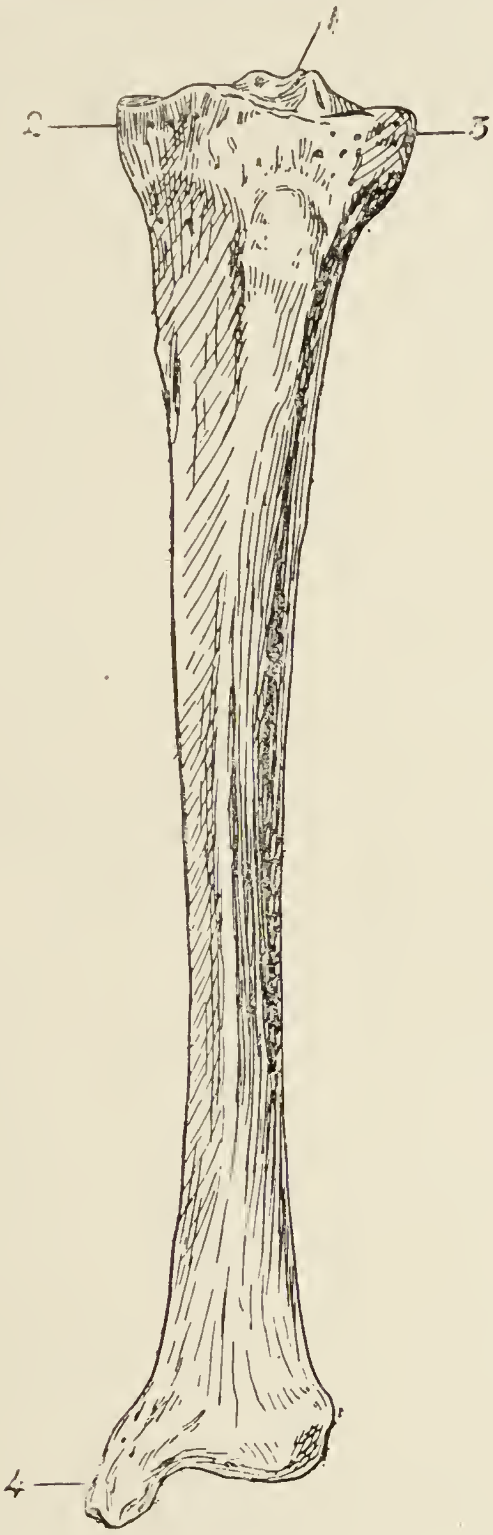

FIG. 50.—TIBIA.

, Spine; 2, internal tuberosity; 3, external tuberosity; 4, internal malleolus.

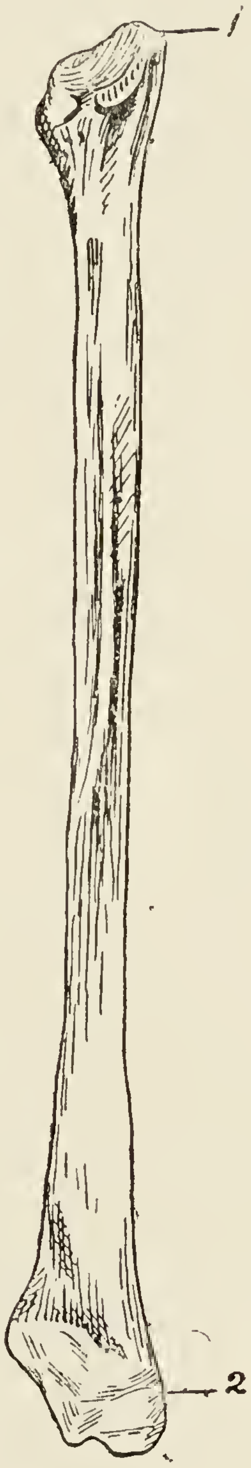

FIG. 51.—FIBULA.

1, Styloid process; 2, external malleolus.

the lower end of the external malleolus articulates with the astragalus and forms the outer ankle. An interosseus membrane stretches between the tibia and fibula, and gives attachment to muscles. The patella is the third bone of the knee-joint; it is a sesamoid bone developed in the tendons of the extensor quadriceps muscles.

The Foot.

There are twenty-six bones in the foot. Seven form the tarsus, or instep:

1. **Os calcis,**
2. **Astragalus,**
3. **Scaphoid,**
4. **Cuboid,**
5. **Inner, or first cuneiform,**
6. **Middle, or second cuneiform,**
7. **Outer, or third cuneiform.**

The **os calcis,** or heel-bone, is the largest and strongest of the tarsal bones.

The **astragalus** is a large bone which fits into the os calcis behind and the scaphoid in front; it also articulates with the inner and outer malleoli.

The **scaphoid** is on the inner side of the foot, between the astragalus and the cuneiform bones. The cuboid is at the other side of the foot, between the os calcis and the two outer metatarsal bones.

The **cuneiform** bones are wedge-shaped, and are between the scaphoid and three inner metatarsal bones.

There are **five metatarsal** bones, which articulate at their bases with the tarsal bones, and at their heads with the bones of the toes. There are fourteen phalanges, arranged as in the fingers.

There are **two sesamoid** bones in the tendons of the great toe and in other tendons of the foot.

LIGAMENTS OF THE LOWER LIMB.

The ligaments of the **hip-joint** are:

1. **Capsular,**
2. **Ligamentum teres,**
3. **Cotyloid,**
4. **Transverse.**

The capsular surrounds the joint: it is attached to the acetabulum, to the innominate bone outside the rim of the cavity, to the cotyloid and transverse ligaments. Thickened

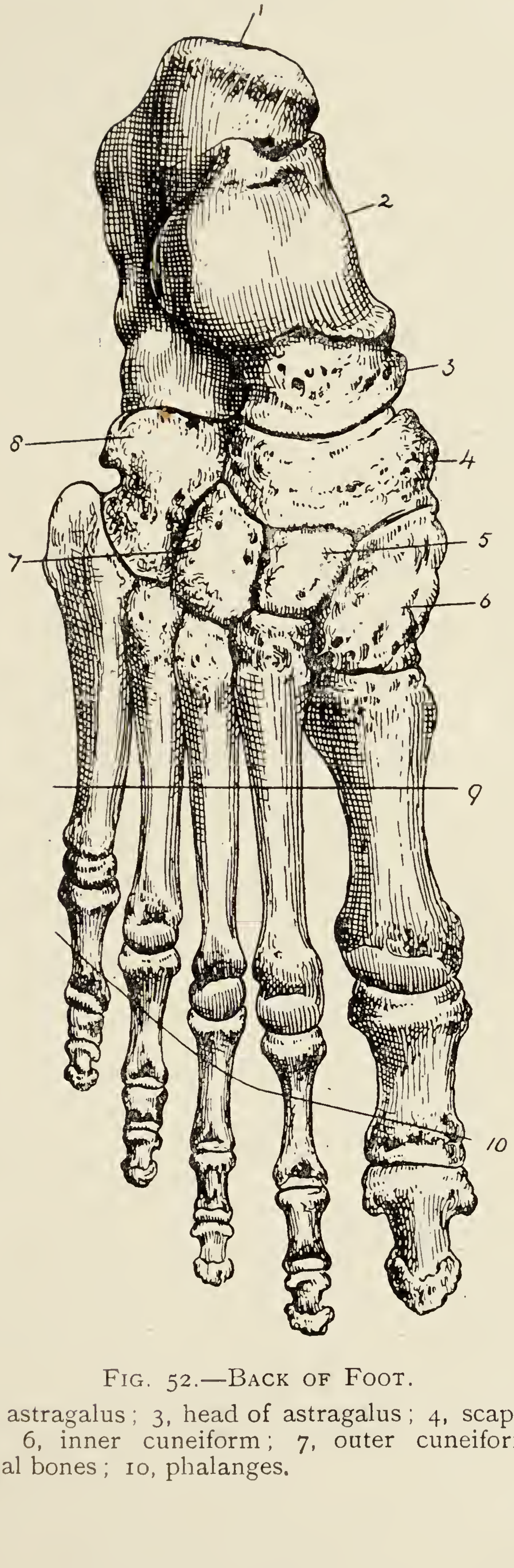

Fig. 52.—Back of Foot.

1, Os calcis; 2, astragalus; 3, head of astragalus; 4, scaphoid; 5, middle cuneiform; 6, inner cuneiform; 7, outer cuneiform; 8, cuboid; 9, metatarsal bones; 10, phalanges.

portions of the capsular are called accessory ligaments. They are:

1. **Ilio-femoral,**
2. **Pubo-femoral,**
3. **Ischio-capsular,**
4. **Zonular band.**

These, as their names imply, pass from (*a*) the ilium, (*b*) the pubis, (*c*) the ischium to the femur. The last partially encircles the neck of the femur.

The **ligamentum teres** is inter-articular; it is attached to a depression in the centre of the head of the femur by one end; the other end, which divides in two, is fixed to the margins of the notch in the acetabulum, and to the transverse ligament.

The **cotyloid ligament** surrounds the brim of the cavity, bridges over the notch, closely fits the head of the femur, and acts as a sucker.

The **transverse ligament** is continuous with the cotyloid, and crosses the notch in the bone, leaving a small opening for bloodvessels and nerves.

Synovial Membrane.—There is a pad of fat at the bottom of the acetabulum, covered by synovial membrane, which also invests the ligamentum teres and covers both surfaces of the cotyloid ligament; it lines the interior of the capsules, and covers the head of the femur.

Bursæ.—There are three bursæ in connection with the gluteus maximus muscle, one between the fascia lata, into which the muscle is inserted, and the great trochanter of the femur; the second is immediately below this; the third is between the muscle and the tuberosity of the ischium.

There is a bursa between the tendon of the obturator internus and the small sciatic notch.

The blood-supply of the joint is from the internal circumflex and obturator arteries. The nerve-supply is from the obturator and anterior crural nerves.

The ligaments of the **knee-joint** are, on the exterior:

1. **The capsular,**
2. **Two lateral,**
3. **Ligamentum patella,**
4. **Posterior ligament.**

These ligaments completely invest the joint.

The *external* lateral ligament is attached to the outer tuberosity of the femur, and to the head of the fibula, below the styloid process.

The *internal* lateral ligament is attached to the inner tuberosity of the femur, and below the inner tuberosity of the tibia.

The *capsular* ligament fills up the intervals between the lateral and anterior ligaments.

The **ligamentum patellæ** is attached to the lower border of the patella and the anterior tubercle of the tibia. It is the final insertion of the quadriceps extensor of the thigh.

The **crucial ligaments**, so called because they form a X, are within the joint. The *anterior* crucial ligament arises from the upper surface of the tibia in front of the spine, and is attached to the back part of the external condyle of the femur. The *posterior* crucial ligament arises from the upper surface of the tibia behind the spine, and is attached to the front part of the internal condyle. In flexion of the knee the posterior ligament tightens, in extension the anterior tightens.

Semilunar Cartilages.—Between the femur and the tibia, and attached to the latter, are two plates of fibro-cartilage, called, from their shape, semilunar; the horns of each crescent are fixed to the upper surface of the tibia. The two crescents are united by a fibrous band, called the transverse ligament, and the cartilages are held to the tibia by the coronary ligaments.

The **synovial membrane** is the largest in the body; it covers both surfaces of the semilunar cartilages, partly invests the crucial ligaments, lines the ligaments on the outside of the joint, and is prolonged for about an inch above the joint on the femur, and below it on the back of the tibia. There is a small bursa between the ligamentum patellæ and the anterior tubercle of the tibia, a larger one on the front of the femur above the patella, and others in the neighbourhood of the joint.

The blood-supply is from branches of the popliteal artery.

The nerve supply is from the anterior crural, external and internal popliteal, and the obturator nerves — ten branches in all.

The ligaments of the **ankle-joint** are:

1. **Anterior,**
2. **Posterior,**
3. **Internal lateral,**
4. **External lateral.**

The anterior and posterior ligaments are attached in front and behind to the articulating surfaces of the tibia and the astragalus.

The internal lateral passes from the inner malleolus to the astragalus, os calcis and scaphoid.

The external lateral passes from the outer malleolus to the astragalus and os calcis. Synovial membrane lines these ligaments and passes a little way up between the bones of the leg.

A bursa lies between the tendo Achillis and the upper part of the back of the os calcis.

A strong membrane stretches between the tibia and fibula, as between the bones of the arm.

The two principal movements of the ankle-joint are flexion (dorsi-flexion) and extension (plantar flexion). Movements of abduction, adduction and circumduction can be made by extending the foot. These movements are more limited than in the wrist, because the bones of the ankle fit more closely.

The tibia and fibula articulate with each other at their upper and lower extremities. Each articulation has its own ligaments and synovial membrane.

The tarsal and metatarsal bones are bound together by interosseous, plantar, and dorsal ligaments. The two most important in preserving the arch of the foot are the inferior calcaneo-scaphoid, and the two plantar calcaneo-cuboid; as their names imply, they are attached to the heel-bone and to the scaphoid and cuboid ; the long plantar calcaneo-cuboid is also attached to the three middle metatarsal bones.

The transverse metatarsal ligament stretches across the heads of the metatarsal bones as the corresponding ligament does in the hand.

The anterior annular ligament of the ankle consists of two parts. The upper part stretches across the front of the leg and is attached to the tibia and fibula; the lower part is over the joint and is attached externally to the anterior of the os calcis, and internally to the inner malleolus and inner margin of the foot.

The .internal annular ligament bridges over the hollow between the os calcis and inner malleolus.

The external annular ligament bridges over the hollow between the os calcis and the outer malleolus. The blood supply is from the posterior tibial artery. The nerve supply is from the anterior tibial nerve.

The **muscles** chiefly concerned in producing movements of the joints of the lower limb are as follows :

Hip.

Flexion : iliacus, psoas, pectineus.

Extension : gluteus maximus and medius.

Abduction : upper part of gluteus maximus, medius, and minimus.

Adduction : adductors magnus longus and brevis, pectineus, lower part of gluteus maximus, obturator externus.

Rotation *inward :* anterior part of gluteus medius, anterior part of gluteus minimus, tensor fascia femoris, ilio-psoas.

Rotation *outward :* obturators, gemelli, pyriformis, gluteus maximus.

Knee.

Flexion : biceps, popliteus, sartorius, gracilis, semitendinosus, semimembranosus.

Extension : extensor quadriceps.

Ankle.

Flexion : tibialis anticus, peroneus tertius.

Extension: gastrocnemius, soleus, tibialis posticus, peroneus longus and brevis.

Toes.

Flexion, extension, abduction and adduction of first phalanx are, as in fingers, by lumbricales and interossei.

Inversion of foot : tibialis anticus, tibialis posticus.

Eversion of foot : the three peronei.

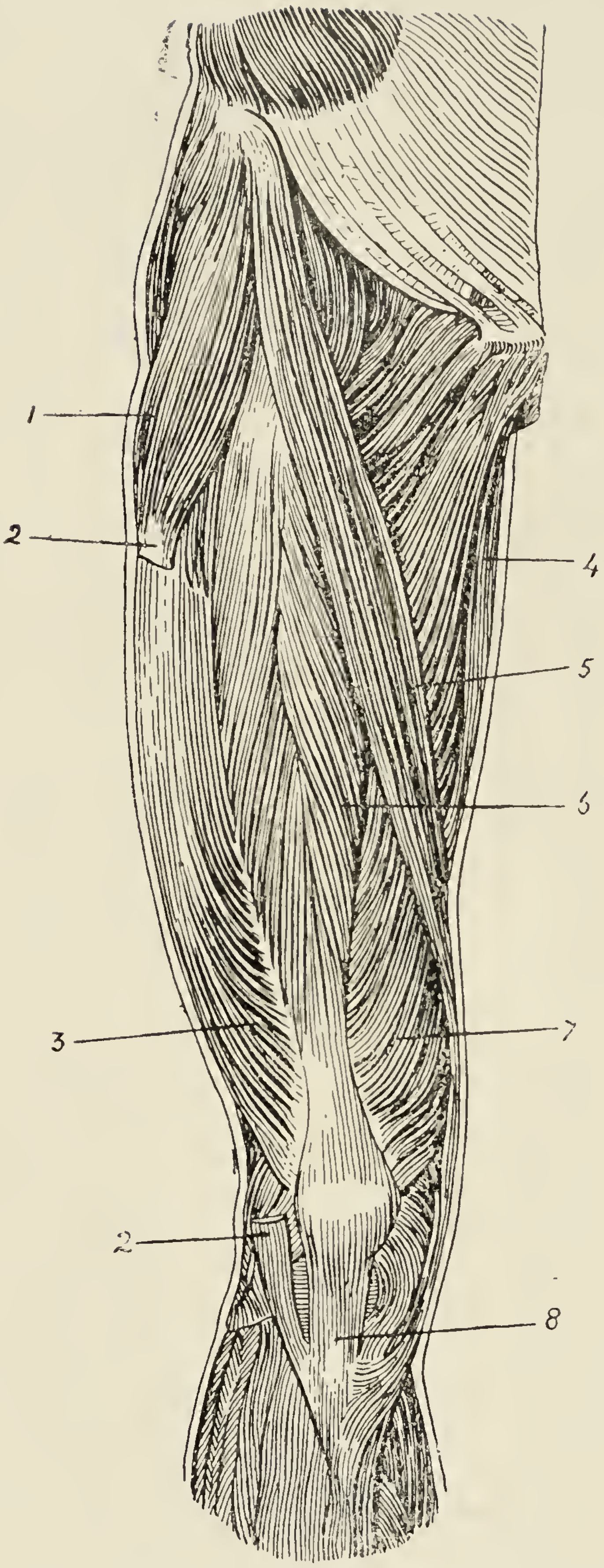

Fig. 53.—Muscles of Thigh (Anterior View).

1, Tensor fascia femoris; 2, ilio-tibial band; 3, vastus externus; 4, gracilis; 5, sartorius; 6, rectus femoris; 7, vastus internus; 8, ligamentum patella.

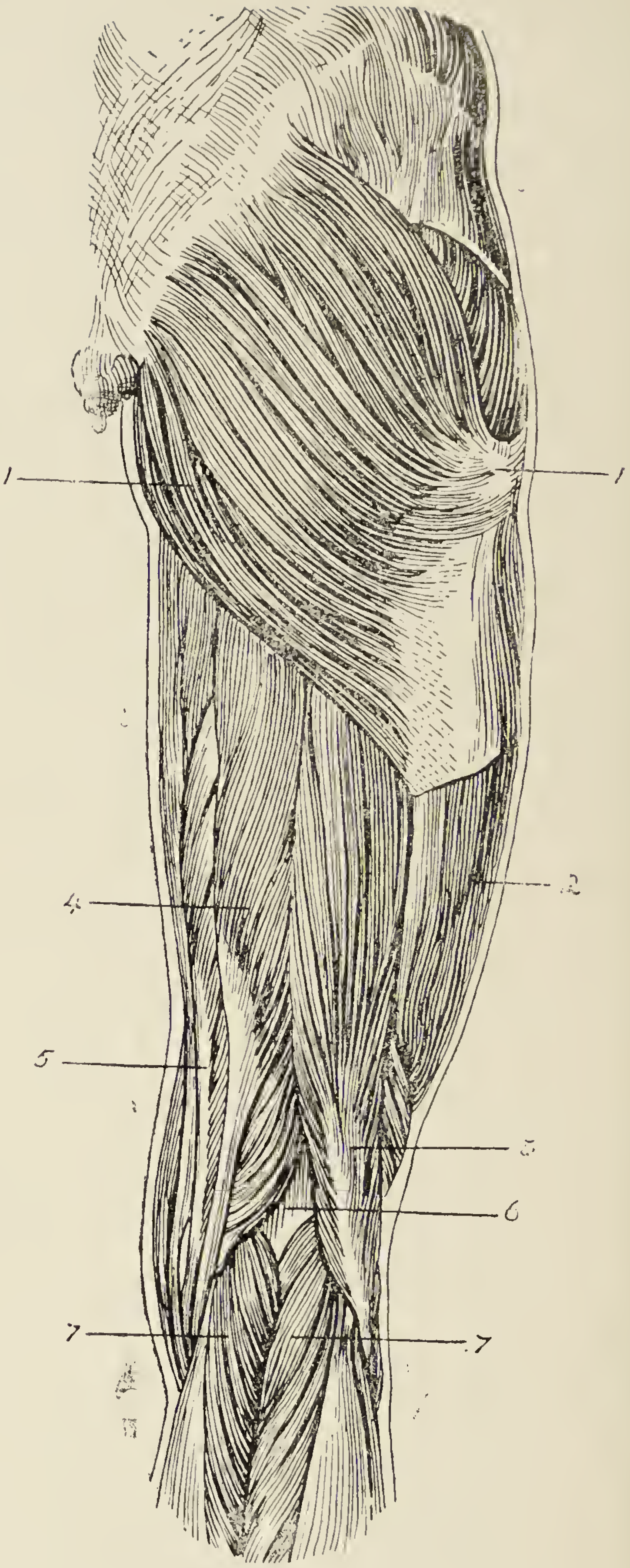

Fig. 54.—Muscles of Thigh (Posterior View).

1, Gluteus maximus; 2, vastus externus; 3, biceps; 4, semi-tendinosus; 5, semi-membranosus; 6, popliteal space; 7, gastrocnemius.

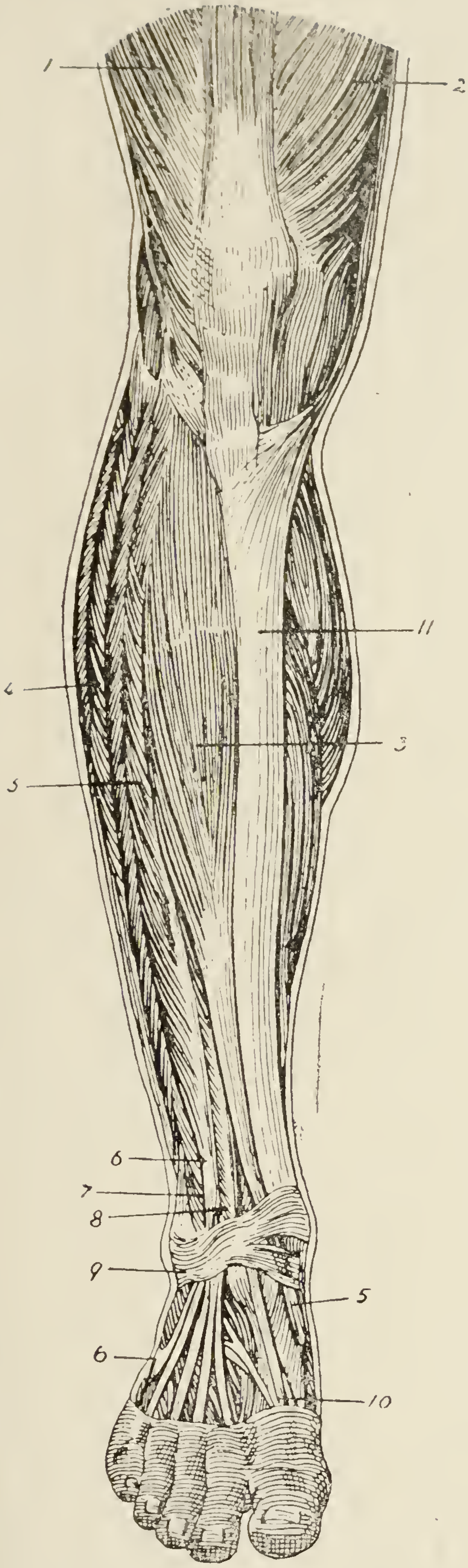

Fig. 55.—Muscles of Leg (Anterior View).

1, Vastus externus; 2, vastus internus; 3, tibialis anticus; 4, peroneus longus; 5, extensor longus; 6, peroneus tertius; 7, extensor longus pollicis; 8, annular ligament.

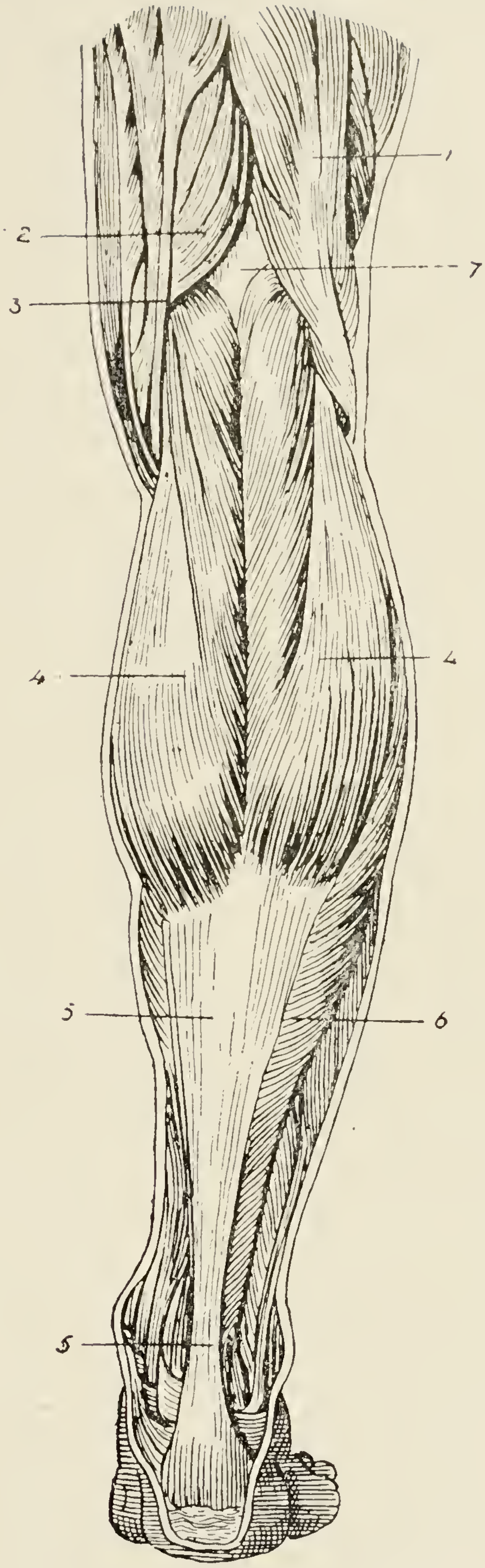

Fig. 56.—Superficial Muscles of Calf of Leg.

1, Biceps; 2, semitendinosus; 3, semimembranosus; 4, gastrocnemius; 5, tendo Achillis; 6, soleus.

MUSCLES OF THE LOWER LIMB.

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Gluteus maximus.	Superior curved line and crest of ilium, sacrum, coccyx.	Fascia. Femur below trochanter.	Rotates and abducts thigh. Extends hip-joint.	Branch from inferior gluteal.
Gluteus medius.	Outer surface and crest of ilium.	Oblique line of great trochanter.	Rotates and abducts thigh. Extends hip-joint.	Superior gluteal.
Gluteus minimus.	Between middle and inferior lines of ilium.	Front of great trochanter.	Rotates and abducts thigh. Extends hip-joint.	Superior gluteal.
Pyriformis.	Front of sacrum.	Top of great trochanter.	Rotates and abducts thigh. Extends hip-joint.	Branches from sacral plexus.
Obturator internus.	Obturator foramen and membrane. Front of ilium.	Top of great trochanter.	Rotates and abducts thigh. Extends hip-joint.	Branches from sacral plexus.
Obturator externus.	Outside obturator foramen and membrane.	Root of great trochanter.	Rotates and abducts thigh. Extends hip-joint.	Obturator.
Superior gemellus.	Ischial spine.	Tendon of obdurator internus.	Rotates and abducts thigh. Extends hip-joint.	Branches from sacral plexus.

Inferior gemellus.	Ischial spine.	Tendon of obdurator internus.	Rotates and abducts thigh. Extends hip-joint.	Branches from sacral plexus.
Quadratus femoris.	Tuberosity of ischium, transverse process of lumbar vertebræ.	Quadrate line of femur.	Rotates and adducts thigh.	Branches from sacral plexus.
Biceps femoris, two heads.	(1) Tuberosity of ischium. (2) Linea aspera.	Styloid process of fibula.	Flexes and rotates leg outwards.	Great sciatic.
Semimembranosus.	Tuberosity of ischium.	Inner tuberosity of tibia.	Flexes leg and rotates it inwards.	Great sciatic.
Semitendinosus.	Tuberosity of ischium.	Inner tuberosity of tibia.	Flexes leg and rotates it inwards.	Great sciatic.
Adductor longus.	Front of pubes.	Middle linea aspera.	Adducts and flexes thigh.	Obturator.
Adductor brevis.	Ramus of pubes.	Upper part linea aspera.	Adducts and flexes thigh.	Obturator.
Adductor magnus.	Rami of pubes and ischium.	All linea aspera. Inner condyle. Adductor tubercle.	Adducts and rotates thigh.	Obturator, and great sciatic.
Gracilis.	Rami of pubes and ischium.	Inner and upper surface of tibia.	Adducts thigh and flexes leg.	Obturator.
Pectineus.	Ilio-pectineal line pubes.	Below lesser trochanter.	Adducts thigh and flexes it.	Anterior crural and obturator.

MUSCLES OF THE LOWER LIMB—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Psoas magnus.	Bodies and transverse processes, last dorsal and all lumbar vertebræ.	Lesser trochanter.	Flexes and rotates thigh outward; flexes trunk on thigh.	Third lumbar.
Iliacus.	Iliac fossa and crest, base of sacrum.	Lesser trochanter, shaft of femur and psoas muscle.	Flexes and rotates thigh outward; flexes trunk on thigh.	Anterior crural.
Sartorius.	Anterior superior spine of ilium.	Upper inner shaft of tibia.	Flexes and crosses leg.	Anterior crural.
Tensor fasciæ femoris.	Crest and anterior superior spine and notch of ilium.	Fascia lata.	Acts with gluteus max. in tightening fascia lata, abducts thigh.	Superior gluteal.
Rectus femoris.	Anterior inferior iliac spine. Upper brim acetabulum.	Anterior tubercle of tibia.	Quadriceps extensor. All extend leg. Rectus also flexes thigh.	Anterior crural.
Vastus externus.	Neck of femur and great trochanter.	Anterior tubercle of tibia.		Anterior crural.
Vastus internus.	Small trochanter and linea aspera.	Anterior tubercle of tibia.		Anterior crural.
Crureus.	Anterior and inner shaft of femur.	Anterior tubercle of tibia.		Anterior crural.

Tibialis anticus.	Outer tuberosity of tibia, upper part of shaft.	Internal cuneiform and first metatarsal bones.	Flexes foot on leg, inverts it, raises inner border.	Anterior tibial.
Extensor longus digitorum.	Outer tuberosity of tibia, head of fibula.	Second and third phalanges of toes by four tendons.	Extends toes.	Anterior tibial.
Extensor longus pollicis.	Middle shaft of tibia.	Last phalanx of great toe.	Extends great toe.	Anterior tibial.
Peroneus tertius.	Lower part of anterior and inner surface of fibula.	Dorsal surface, fifth metatarsal bone.	Flexes and everts foot.	Anterior tibial.
Peroneus longus.	Head and outer surface shaft of tibula.	Under surface, base of first metatarsal bone.	Extends and everts foot.	Musculo-cutaneous.
Peroneus brevis.	Shaft of tibula below longus.	Base of fifth metatarsal bone.	Extends and everts foot.	Musculo-cutaneous.
Gastrocnemius, two heads.	(1) External condyle femur. (2) Internal condyle femur.	Os calcis by tendo Achillis.	Extends foot, bends knee.	Branch from internal popliteal.
Soleus.	Heads of tibia and fibula.	With gastrocnemius into os calcis by tendo Achillis.	Extends foot.	Branch from internal popliteal.

MUSCLES OF THE LOWER LIMB—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Plantaris.	Back of femur above external condyle.	Os calcis near or with common tendon of gastrocnemius and soleus.	Assists gastrocnemius in extending foot and bending knee.	Branch from internal popliteal.
Popliteus.	External condyle of femur by tendon within capsule of knee-joint.	Shaft of tibia.	Bends knee, rotates tibia inwards.	Branch from internal popliteal.
Flexor longus pollicis.	Posterior surface shaft of fibula.	Last phalanx of great toe.	Flexes great toe and keeps it to the ground.	Posterior tibial.
Flexor longus digitorum.	Posterior surface shaft of tibia.	By four tendons into last phalanges of four small toes.	Flexes toes and keeps them to the ground.	Posterior tibial.
Tibialis posticus.	Shafts of tibia and fibula.	All tarsal bones except astragalus; second, third, fourth metatarsal.	Extends foot, inverts it and pulls toes together, presses down outer border of foot.	Posterior tibial.
Extensor brevis digitorum.	Upper part of os calcis.	Four inner toes.	Extends toes.	Branch from anterior tibial.

Flexor brevis digitorum.	Inner tubercle os calcis and plantar fascia.	First phalanges four outer toes by four tendons.	Flexes toes.	Internal plantar.
Abductor pollicis.	Inner tubercle os calcis and plantar fascia.	Inner side first phalanx of great toe.	Abducts great toe.	Internal plantar.
Abductor minimi digiti.	Inner tubercle os calcis and plantar fascia.	First phalanx of little toe.	Abducts little toe.	External plantar.
Flexor accessorius, two heads.	(1) Os calcis, inner side; os calcis, outer side. (2) Plantar ligament.	Tendons flexor longus digitorum.	Accessory flexors of toes.	External plantar.
Lumbricales, four.	Tendons flexor longus digitorum.	Second phalanges of four outer toes.	Accessory flexors of toes.	External and internal plantar.
Flexor brevis pollicis.	Cuboid and external cuneiform bones.	Base first phalanx of great toe.	Flexes great toe.	Internal plantar.
Adductor pollicis.	Third and fourth metatarsal bones.	Base first phalanx of great toe.	Adducts great toe.	External plantar.
Transversus pedis.	Head fifth metatarsal bone.	Base first phalanx of great toe.	Brings edges of foot together.	External plantar.

MUSCLES OF THE LOWER LIMB—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Flexor brevis minimi digiti.	Base fifth metatarsal bone.	First phalanx of little toe.	Flexes little toe.	External plantar.
Dorsal interossei, four.	Sides of outer three metatarsal bones.	Base of corresponding toes and expansions of extensor tendons.	Abducts toes from middle line.	External plantar.
Plantar interossei, three.	Sides of outer three metatarsal bones.	Base corresponding toes.	Adducts toes from middle line.	External plantar.

FASCIA.

The *superficial* fascia in the gluteal region is laden with fat, especially in females. It becomes tough and elastic over the tuberosity of the ischium. On the rest of the limb it is the same as on the other parts of the body.

The *deep* fascia is attached to the crest of the ilium, the sacrum and coccyx, and is continuous into the back of the thigh, where it becomes very thin. On the thigh it is called fascia lata. On the front of the thigh it is attached to the bones of the pelvis and to Poupart's ligament; it forms a firm investment to the limb, strongest on the outer side where the tensor fascia femoris muscle, and a portion of the gluteus maximus are inserted into it. On the inner side it is thin. Besides investing the limb, the fascia lata forms sheaths to the muscles and partitions or septa between the various groups.

On the leg the deep fascia is thick at the upper part in front, and thick at the upper part at the back. At the ankle it forms thickened bands, which are the annular ligaments which hold the tendons in position.

The superficial and deep fascia of the sole of the foot are both very thick.

BLOODVESSELS OF THE LOWER LIMBS.

Arteries.

The **external iliac artery**, one of the two divisions of the common iliac artery, is the beginning in the abdomen of the main artery which supplies the lower limb. It passes downward and outward, and into the thigh behind Poupart's ligament, where it becomes the femoral artery. It extends down to the opening in the adductor magnus muscle, which is on the inner aspect of the lower third of the thigh. About 2 inches from Poupart's ligament it bifurcates; the deep branch called the profunda femoris passes behind the adductor longus, and continues downwards close to the shaft of the femur; it gives off several branches, which supply many of the muscles of the thigh.

The **popliteal artery** is continuous with the femoral artery.

It ends at the lower border of the popliteus muscle by dividing into the anterior and posterior tibial arteries.

The **anterior tibial** passes to the front of the leg by an opening in the interosseous membrane, and proceeds down to the ankle and the dorsum of the foot, where it becomes the dorsal artery.

The **posterior tibial** goes down the back of the leg under the superficial muscles of the calf; at the ankle, between the heel and the inner ankle-bone, it divides into the internal and external plantar arteries, which unite with the dorsal artery to form the plantar arch, which supplies blood to the foot.

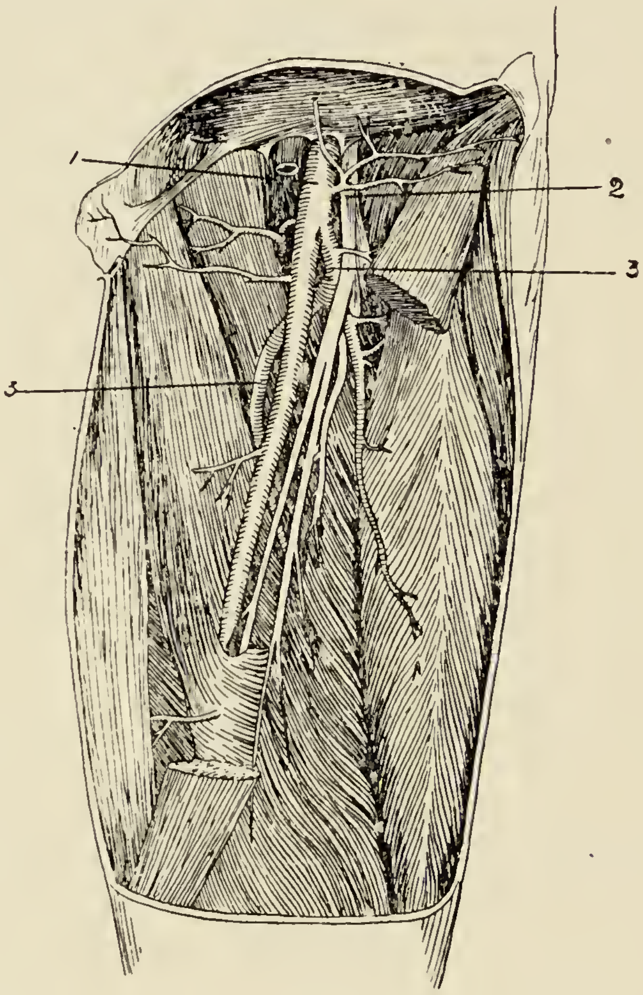

FIG. 57.—1, Femoral artery; 2, anterior crural nerve; 3, deep femoral artery.

Veins.

The veins of the lower limb, like those of the upper limb, are arranged in a superficial and deep set. The deep veins accompany their respective arteries, and are called by their names. The superficial veins are the

Internal, or Long Saphenous.
External, or Short Saphenous.

The **internal saphenous** commences at the inner side of the venous arch, on the dorsum of the foot. It passes in front of the inner malleolus, and extends up the leg and inner side of the knee to the thigh, when it inclines forward, but goes up still on the inner aspect of the thigh, and joins the femoral vein by passing through an opening in the deep fascia, called the saphenous opening, about 2 inches below Poupart's ligament.

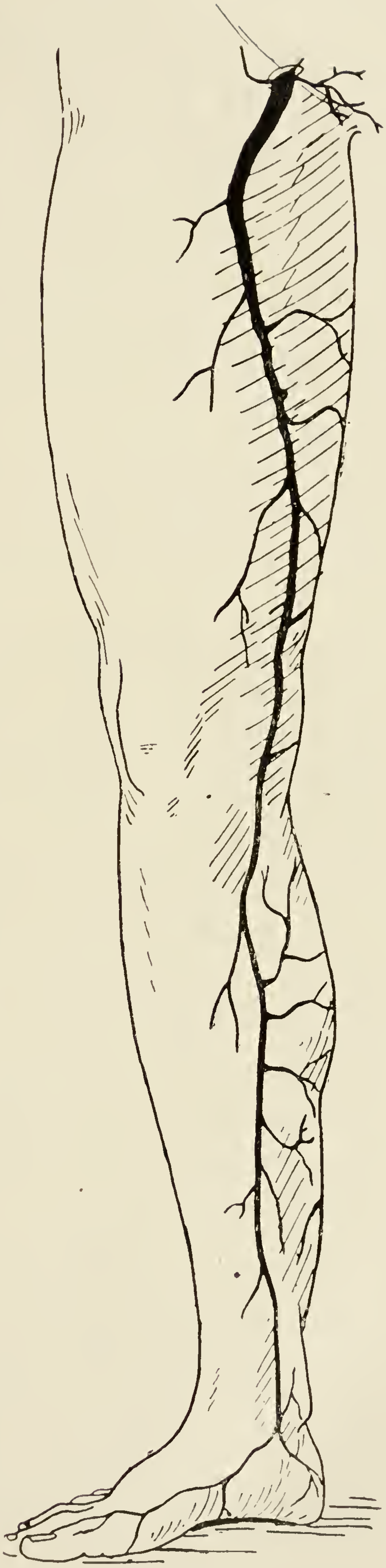

FIG. 58.—LONG SAPHENOUS VEIN.

The **external saphenous** commences at the outer side of the dorsal arch, and passes behind the outer malleolus; it ascends the back of the leg to the lower part of the popliteal space, when it pierces the deep fascia and joins the popliteal vein.

Both deep and superficial veins pour their contents into the external iliacs; the internal and external iliacs unite to form the common iliac veins; the two common iliacs unite to form the inferior vena cava, which pierces the diaphragm, and carries the blood from all parts of the body below the heart to the lower part of the right auricle.

The valves in the veins of the lower limb are more numerous than in those of the upper limb.

The arteries send off branches all along their course. The veins receive tributaries.

LYMPHATICS.

There is a group of lymphatic glands in the popliteal space, two or three at each side of the popliteal artery; they receive the deep lymphatics from the leg, and the superficial set which accompanies the external saphenous vein.

The femoral group are in the thigh along the internal saphenous vein. The superficial vessels of the lower limb enter these, and pass through the saphenous opening to join the glands which lie along the femoral and external iliac arteries.

The inguinal glands—another group—lie across the top of the thigh on the line of Poupart's ligament, and receive vessels from the surface of the abdomen and buttocks.

CHIEF NERVES OF THE LOWER LIMBS.

The **anterior crural** nerve arises from the lumbar plexus, and enters the thigh behind Poupart's ligament between the psoas and iliacus muscles. It divides into an anterior and posterior portion, from which numbers of cutaneous and muscular branches spread over the front of the thigh.

The **long saphenous** nerve is the longest branch of the anterior crural. It goes down the thigh with the femoral vessels, and in the leg accompanies the long saphenous vein. It ends on the inner side of the foot.

The **obturator nerve**, also a branch of the lumbar plexus, divides into an anterior and posterior portion before it leaves the pelvis by the obturator foramen. The anterior division proceeds down on the anterior surface of the adductor brevis muscle. The posterior division goes down between the adductor brevis and adductor magnus.

The **great sciatic nerve** is the largest branch of the sacral plexus, and the largest nerve in the body. It issues from the pelvis through the lower part of the great sacro-sciatic foramen, under the pyriformis muscle, about midway between the great trochanter and the tuberosity of the ischium. It passes down the middle of the back of the thigh on the adductor magnus muscle. It is at first superficial, but soon passes under the long head of the biceps muscle. About two-thirds down the thigh it divides into the internal and external popliteal nerves.

The **internal popliteal nerve** is the direct continuation of the great sciatic; it becomes superficial as it emerges from under the biceps, and goes down the middle of the popliteal space to its lower border.

The **posterior tibial nerve** is the continuation of the internal popliteal; it passes down the middle of the calf under the soleus muscle; towards the ankle it inclines inwards, and between the heel and the inner ankle-bone it divides into the internal and external plantar nerves.

The **plantar nerves** go to the sole of the foot and toes.

Thus the **sciatic nerve** and its continuations form an almost direct line from the pelvis to the foot. They are closely associated with arteries of the same names and their accompanying veins.

The **external popliteal nerve**, the smaller division of the great sciatic, proceeds down the outer border of the popliteal space, along the inner side of the biceps. It turns round the head of the fibula, and divides into the musculo-cutaneous and anterior tibial.

The **musculo-cutaneous nerve** goes down the outside of the leg in the substance of the peroneus longus muscle; about two-thirds down it becomes cutaneous, inclines forward, passes in front of the outer ankle, and divides into an internal and external branch, which pass to the dorsum of the foot and toes.

The **anterior tibial nerve** goes down the front of the leg, beneath the extensor longus digitorum muscle; at the ankle it divides into an internal and external branch, which continue to the dorsum of the foot and toes. The great sciatic supplies nearly all the muscles of the back of the thigh, and all the muscles of the foot and leg (see table).

The **lesser sciatic nerve** arises from the same plexus, and issues from the pelvis in the same way as the greater sciatic. It is superficial in all its length. At the lower border of the popliteal space it pierces the fascia, and gives twigs to the skin of the upper part of the calf. In the gluteal region it gives recurrent branches to the skin of the buttocks.

The **popliteal space** is a lozenge-shaped space at the back of the knee—it is the ham. It contains the popliteal artery and vein with their branches, the two popliteal nerves, lesser sciatic, a branch of the obturator, and some small lymphatic glands. Above, and to the outer side, is the biceps muscle; above, and to the inner side, are the semimembranosus and semitendinosus muscles; the heads of the gastrocnemius and the plantaris muscle are below. The deep fascia is thin, but strong; it is continuous with the fascia lata of the thigh.

MASSAGE OF THE LOWER LIMB.

The operator faces the patient. The movements are the same as on the arm; some difference is made in the mode of application to suit the shape of the limb. The toes do not admit of so much work as the fingers.

1. Each one is taken between the thumb and index-finger; the thumb strokes upwards on the top, while the fingers make the reverse movement underneath. The first joints are kneaded separately between thumb and finger.
2. The ends of the toes are rubbed the same as the fingers.
3. Joints are flexed and extended, first row also rotated.
4. Dorsum of foot. Friction and effleurage between metatarsal bones.
5. Sole of foot. Kneading with palm of hand, fingers fixed on the outer side, back of the foot supported with the other hand. The movement is more circular than on the hand, owing to the shape of the foot; the palm fits well into the arch. This movement is useful in treatment of flat foot. The right hand is used for the right foot, the left for the left foot.
6. The foot is taken between the two hands, both thumbs are on the inside, rapid to and fro movements are made lengthwise.
7. Effleurage on each side of foot from toe to heel, passing under ankle-bone, and up each side of tendo Achillis.

The Ankle.—1. Friction with thumbs on tarsal and round ankle bones.

2. Effleurage.
3. Kneading with heel of hand.
4. Passive movements.

With one hand the lower end of the leg is grasped, with the other the foot above the toes, the thumb on top, fingers under sole. Flexion, extension, etc., same as wrist.

The Leg.

1. With the whole palmar surface of the hand held lengthwise, effleurage is applied to the inner and outer aspects, and to the back with the hand held transversely.

2. The leg is semi-flexed to relax the muscles; pétrissage to calf with thumbs and fingers, the muscles well picked up and thoroughly worked.

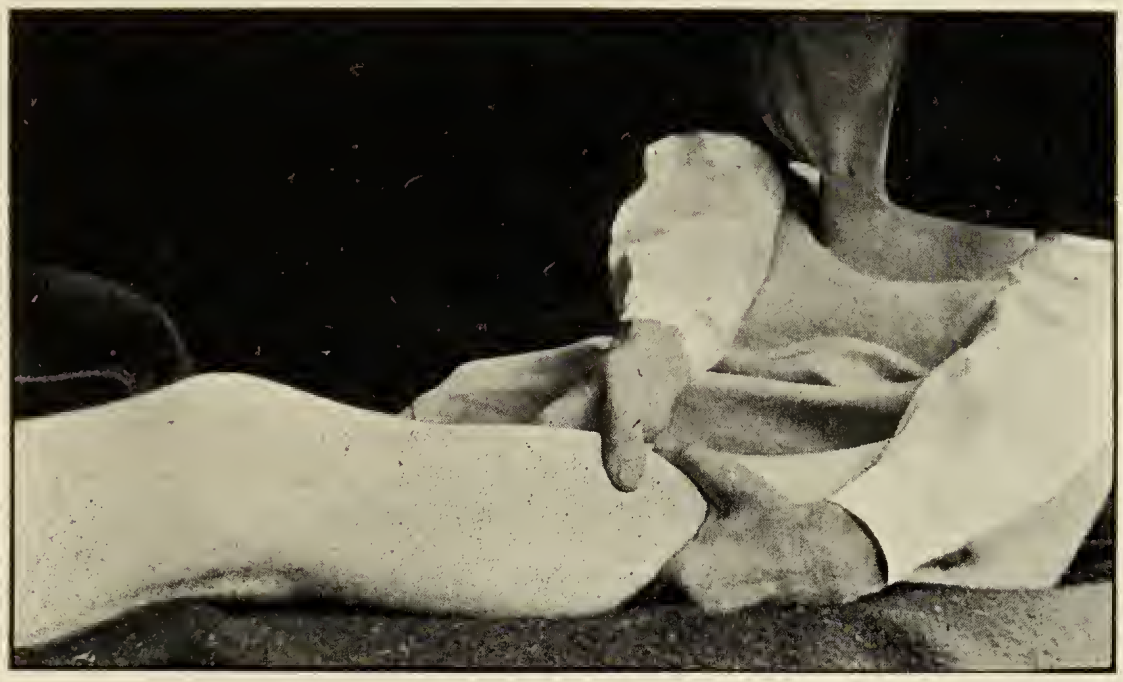

FIG. 59.—KNEADING THE ANTERIOR MUSCLES OF THE LEG WITH THE THUMB.

3. The tibialis anticus is kneaded with both thumbs working crosswise, one pointing inwards, the other outwards; the muscle is well drawn away from the bone, stroking with thumbs over muscle from ankle to knee.

4. The peronei, which are on the outer side of the leg, are kneaded with the heel of the hand.

5. Deep pétrissage, with palms of both hands over same regions, the hand on the inner aspect to be held below the tibia, the other hand to be placed higher up so as to include the tibialis anticus.

6. Fulling at each side and back, avoiding tibia.

7. Squeezing.

8. Slapping with flat fingers, also flail movement.
9. Rolling effleurage.

The Knee.—1. Effleurage.

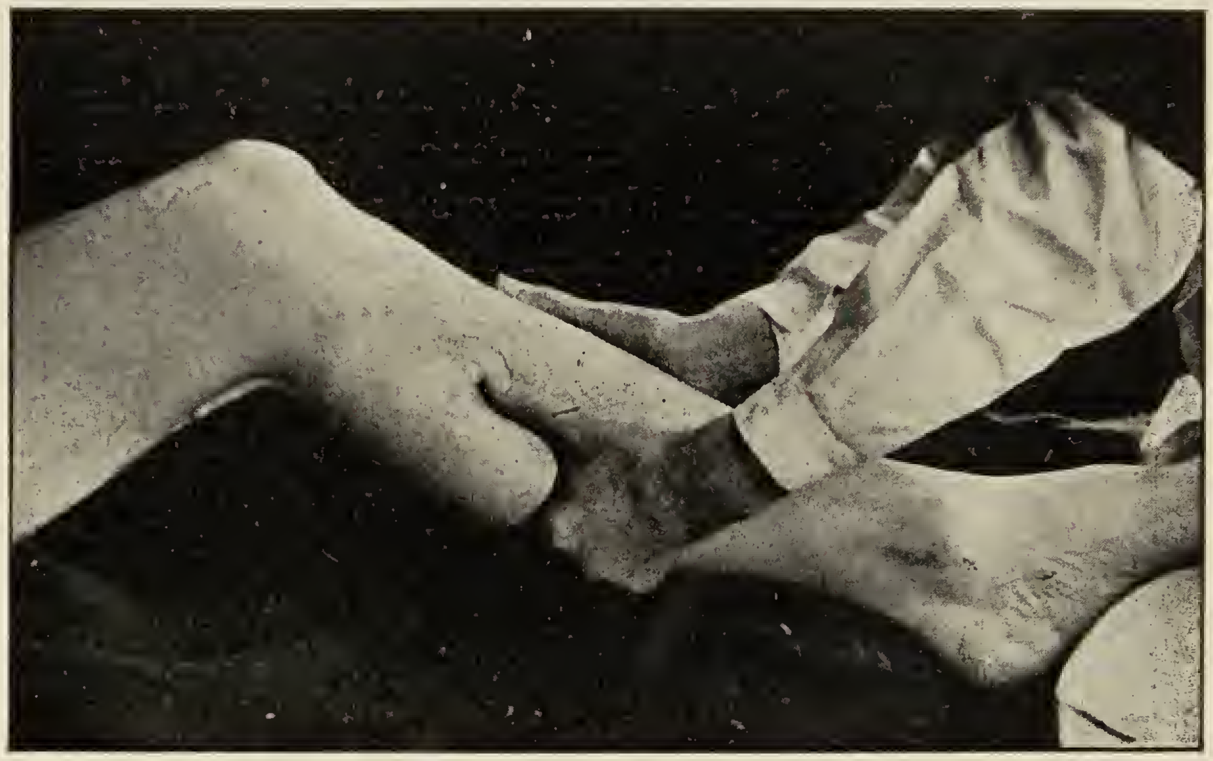

Fig. 60.—Kneading all the Muscles with the Palms.

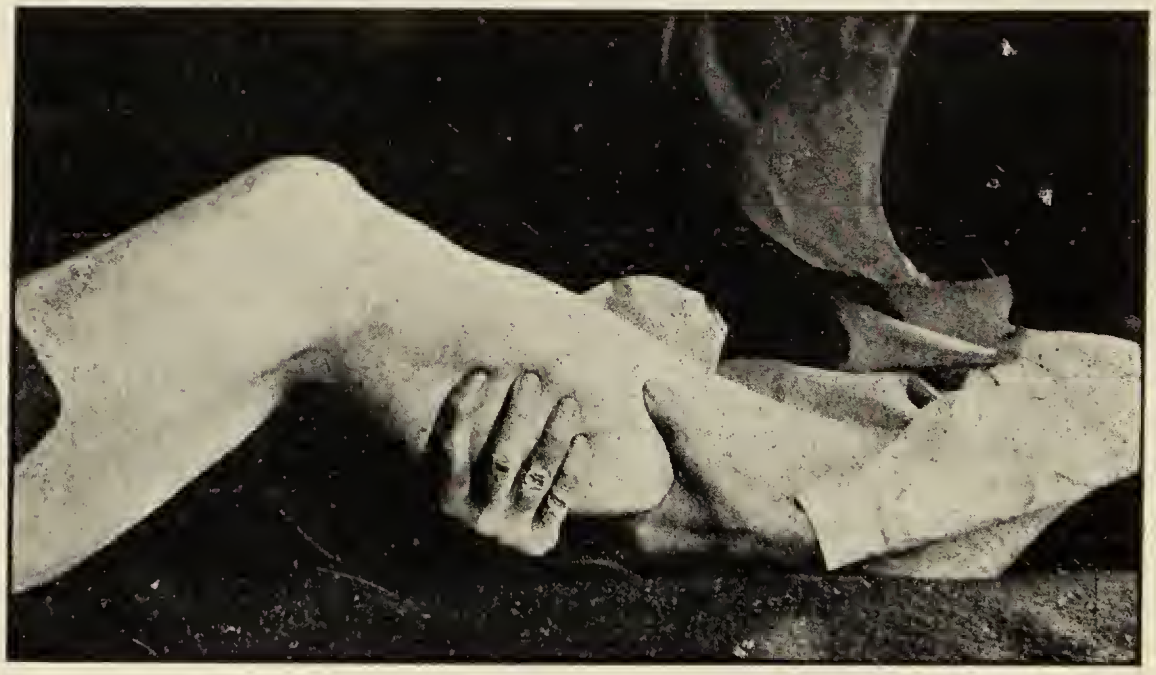

Fig. 61.—Squeezing the Muscles of the Calf.

2. Friction with thumb round patella, beginning below; many small circles are made overlapping each other till the corresponding point above the patella is reached. This is done at each side.

3. The same track is gone over with both thumbs working alternately in a pushing upward movement; advancing slowly, one thumb goes up the inside, the other outside, and meet above the patella. The two thumbs are then drawn round the patella, beginning and ending at same place.

4. These three movements are repeated, a larger circle being made.

5. The hand is cupped and placed above patella, and tissues moved about by a circular movement.

6. Effleurage with both hands going over knee alternately in a circular fashion.

7. Each side of knee, and in the flexure underneath, pétrissage with heel of hand.

8. Effleurage on all aspects.

9. Passive movements.

The ankle is grasped with one hand, and the thigh above the knee with the other; the leg is taken back towards the buttock. If the leg is helpless, or the foot drops, the heel is taken in the hollow of the hand, and the sole rests on the operator's forearm. To extend, the leg is drawn out and the foot at the same time flexed.

The Thigh.

1. The inner and outer aspects are effleuraged with the open hand, the thumb on top and fingers underneath, thus working on the muscles at the back at the same time; one hand supports while the other works; on the top, the strokes are made with the flat hand.

2. The mass of muscles on the inner side is kneaded with thumbs and fingers, muscles on outer side ditto; fingers well under the thigh, so that, on the inner side, the adductors, the inner hamstring, and the gracilis may be enclosed in the grasp, and on the outside the biceps. The top of the thigh is treated in the same way.

3. Deep kneading with palms, fingers again well under, and above-named muscles well grasped with palms from knee to pelvis.

4. Fulling at each side, and with hands above and under thigh.

5. Squeezing. Effleurage between each deep movement. In very large and fat limbs fulling and squeezing are the movements most to be relied on.

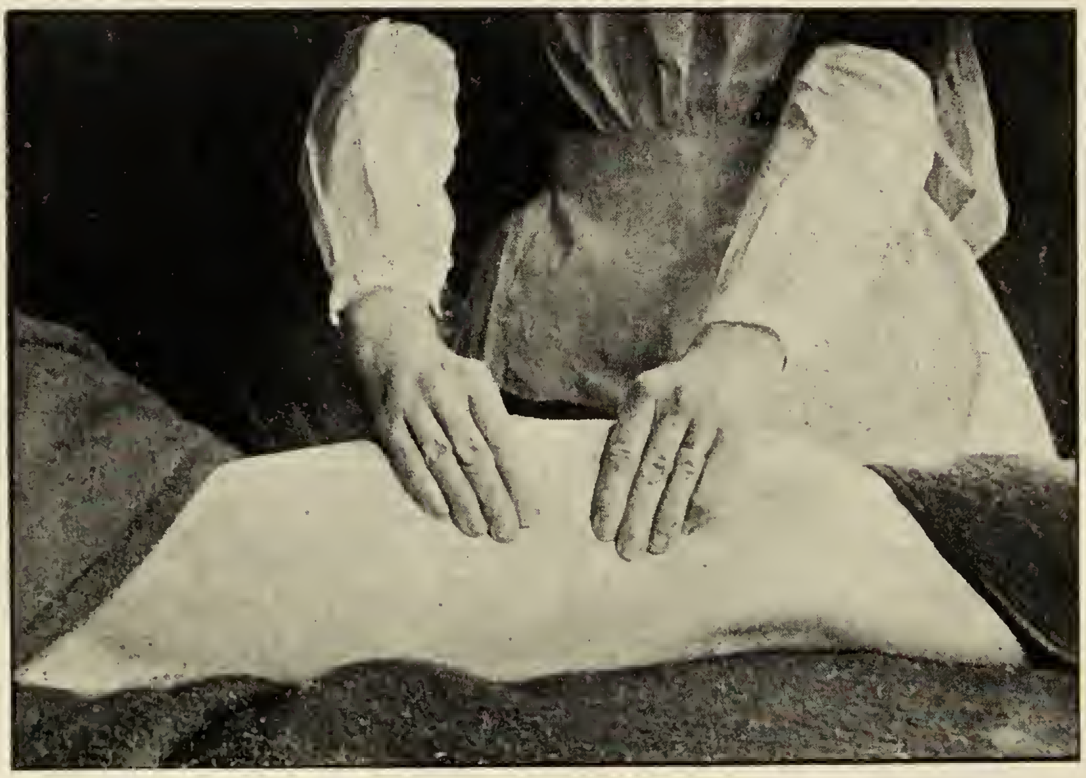

FIG. 62.—KNEADING THE MUSCLES OF THE FRONT OF THE THIGH WITH THE FINGERS AND THUMBS.

6. Tapotement. Fingers shaped like a cone. Ulnar borders of closed hands. Palmar surface of cupped hands.

7. Rolling effleurage.

The Hip Joint.

1. Effleurage.
2. Friction with fingers.
3. Pétrissage with heel of hand.
4. Effleurage.

It is not necessary that all these movements should be used at one time. In general massage it would be impossible, if sufficient time were given to each. Those most suited to the case in hand must be selected.

In very ticklish subjects squeezing and rolling movements are to be preferred at first till the skin gets accustomed to the treatment.

Passive movements are the same as those of the shoulder.

CHAPTER VII

THE TRUNK

BONES.

Spinal Column.
Ribs.
Sternum.
Pelvis.

The **spinal column** is composed of thirty-three vertebræ:

7 **Cervical** (neck).
12 **Dorsal** (back).
5 **Lumbar** (loins).
5 **Sacral** (rump).
4 **Coccygeal** (tail).

Each vertebra consists of an anterior solid portion called the body, and a posterior portion called the arch. Each arch has one spinous, two transverse and four articular processes. The spinous processes project directly backward, and serve for the attachment of muscles. The transverse processes stand out from the sides of the arch at right angles, and also serve for the attachment of muscles. The articular processes stand out obliquely from the arch above and below; the vertebræ are joined by these articular processes.

The plates of bone which form the roof of the arch are called laminæ.

The vertebræ are not all the same, but they are all formed after the same plan, each one having a body, seven processes, two laminæ, two pedicles, and a foramen, except the first cervical, which is little more than a ring. It is called the **atlas**, because it supports the head; and the second cervical,

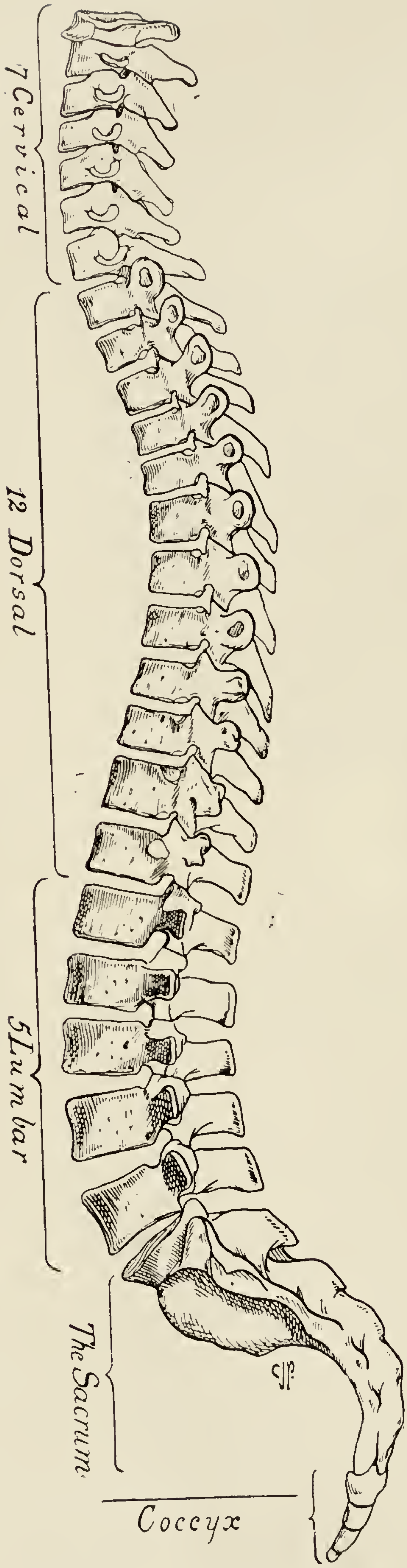

Fig. 63.—Spinal Column.

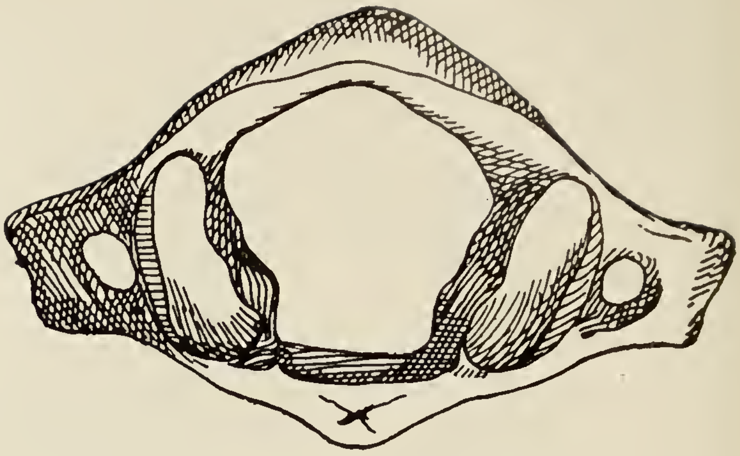

Fig. 64.—First Cervical Vertebra.

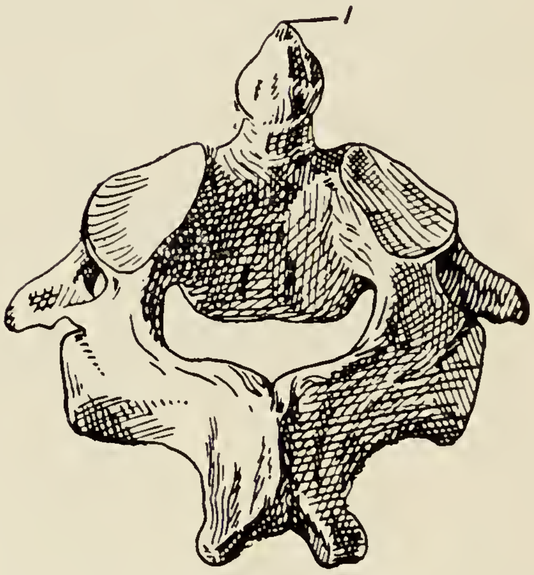

Fig. 65.—Second Cervical Vertebra (from above).

1, Odontoid peg

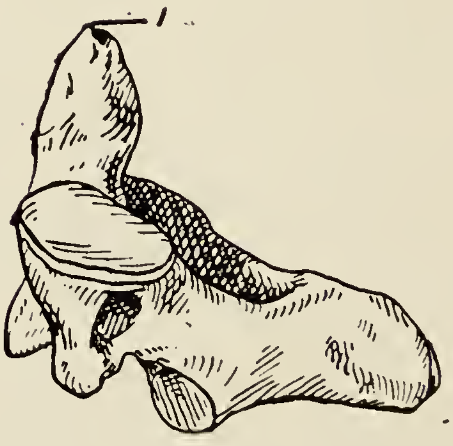

Fig. 66.—Second Cervical Vertebra (from the side).

1, Odontoid peg.

which has a toothlike projection called the **odontoid peg**, supposed to be the detached body of the atlas, is called the **axis**. Round this peg the atlas and head turn, forming a pivot joint. Two spaces are formed in the atlas by a ligament ; the anterior space receives the projection of the axis, the spinal cord passes through the posterior space.

The odontoid peg is attached to the occiput by ligaments. There are two synovial membranes, one in front and one behind the peg.

The nodding movement of the head takes place between the occiput and the articular processes of the atlas. Rotation of the head is the movement of the atlas round the axis ; thus there is a hinge as well as a pivot joint. Too great rotation is checked by certain ligaments.

The cervical vertebræ are the smallest ; the seventh is called vertebra prominans, because of its long spinous process.

The dorsal vertebræ are larger than the cervical. They have facets for the articulation of the ribs.

The lumbar vertebræ are the largest and strongest.

The sacral vertebræ are fused together into a solid bone, as also are the coccygeal, in the adult.

The upper twenty-four vertebræ have intervertebral discs of cartilages, which act as buffers in counteracting shocks, and also give freedom of movement. The movement is more free where the discs are thicker in the lumbar and cervical regions. The discs of cartilage comprise one-fourth of the length of the spinal column.

The posterior portion of the spinal column is called variously the spinal canal, the neural arch, and vertebral foramen. The spinal cord passes through it (see Chapter III.), and the spinal nerves pass out from it through the spaces between the vertebræ.

The spinal column has four natural curves. The convexity is forward in the cervical and lumbar regions, and backward in the dorsal and coccygeal regions.

Ribs.—There are twelve ribs on each side ; the seven upper are true ribs connected with the sternum by their own cartilages. The remaining five are false ribs, three of them are connected indirectly with the sternum by their cartilages, being attached each to the one above it. The last two ribs have no sternal attachment, and are floating ribs.

A rib has a shaft, or body, and two extremities. The vertebral end consists of a head, neck and tubercle.

The facets on the transverse processes of the upper ten dorsal vertebræ are covered with cartilage, and articulate with the tubercles of the ten corresponding ribs. The two lower ribs have no tubercles, and do not articulate with the transverse processes. Each rib from the second to the ninth articulates also with the bodies of the vertebræ and the intervening cartilage by its head. The heads of the remaining four ribs

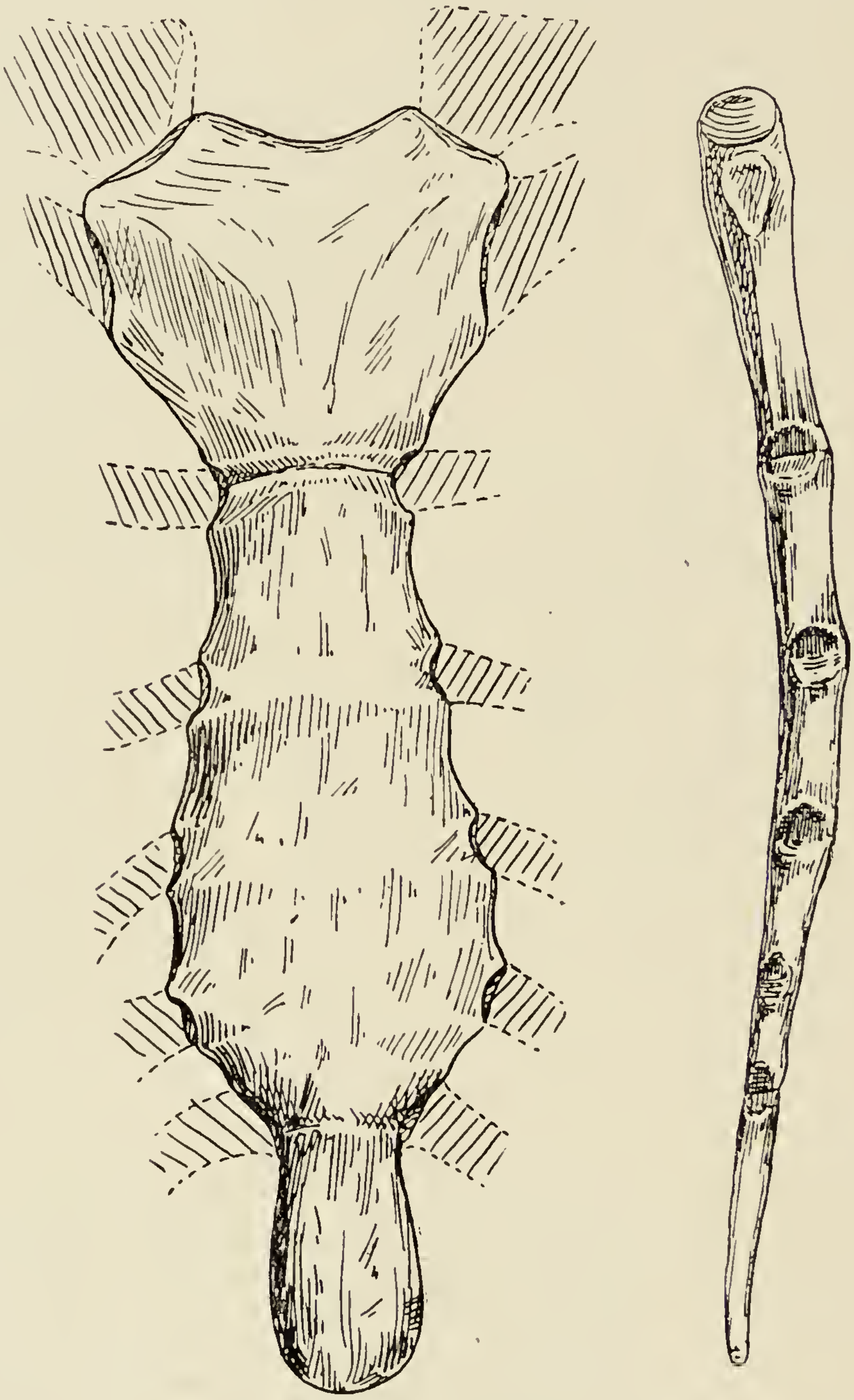

Fig. 67.—Sternum.

join directly with the corresponding vertebræ. The eight ribs between the first and the tenth have two synovial membranes each.

The **sternum** or breast-bone is in the middle line in the front of the chest. It is likened to a sword—the upper part is called the **manubrium**, or handle, the middle part, or body, the **gladiolus**, and the lower part the **ensiform or xyphoid process**; these three parts are also described as presternum, mesosternum and xyphis sternum. At the sides are notches for union with the cartilages of the seven upper ribs.

The contents of the abdomen are supported by, and the weight of the body transmitted to, the lower limbs by the **pelvis**. It is formed by the union of the innominate bones with the sacrum and coccyx.

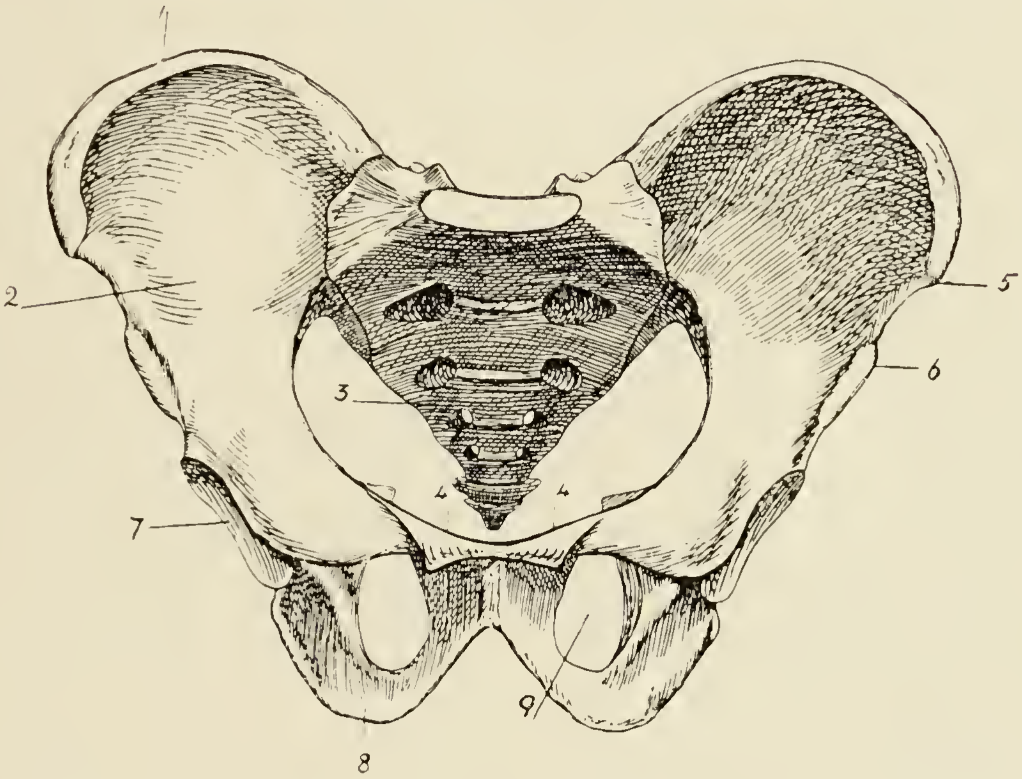

FIG. 68.—THE PELVIS.

1, Crest of ilium; 2, ilium; 3, sacrum; 4, pubes; 5, superior anterior spine; 6, inferior anterior spine of ilium; 7, acetabulum; 8, ischium; 9, obturator foramen.

The **sacrum** consists of five bones of the spinal column, fused together and forming one firm bone. The spinal canal is continued into it, and there are several holes at the side through which nerves pass out.

The **coccyx** is an appendage of the sacrum, and consists of four rudimentary bones fused together. It is the terminal part of the spinal column.

The **innominate bone** is composed of three parts in the child, but united in the adult, though it retains the original names—the **ilium**, the **ischium**, and the **pubis**.

The **ilium** is the upper expanded portion, and is the flank or haunch-bone. It articulates with the sacrum. Plates of cartilage, with synovial membrane between, unite the two bones. This joint is called the **sacro-iliac synchondrosis**; it is slightly movable.

The round, thick border is called the crest of the ilium, from which several muscles arise; the anterior and rather hollowed part is the iliac fossa. The two prominences in front are the anterior superior and the anterior inferior spines of the ilium; two prominences at the back are the posterior superior and posterior inferior spines of the ilium.

The two notches at the back are the great sciatic notch above the inferior spine, and the lesser sciatic below the inferior spine.

The **ischium** is the lowest and back part of the innominate bone. A rough prominence, the tuberosity of the ischium, is the part on which we sit; the part which curves upwards and forwards is the ramus of the ischium. Just above the tuberosity is a large hole called the thyroid or obturator foramen; the obturator membrane is stretched across it, leaving a space for the passage of obturator nerves and bloodvessels.

The **pubis** is the fore part of the innominate bone. It is joined to its fellow of the opposite side by a plate of fibro-cartilage, forming a joint called the **symphysis pubis**.

The descending part is called the descending ramus of the pubis. It joins the ramus of the ischium. The part at which these three bones unite forms the socket into which the head of the femur is received, and which forms the hip-joint. It is called the **acetabulum or cotyloid cavity**.

The top of the symphysis is the crest of the pubis, the sloping part above it is the horizontal ramus.

LIGAMENTS.

The vertebræ are bound together and the column strengthened by several ligaments.

The **supraspinous ligament**, a thick band which connects the points of the spinous processes from the first sacral to the seventh cervical vertebræ.

The **ligamentum nuchæ** is the continuation of the supraspinous to the occipital protuberance, having attachments to all the cervical vertebræ by slips.

The **anterior common ligament** is a strong band in front of the vertebral bodies, firmly fixed to the intervertebral cartilages and to the bones.

The **posterior common ligament** is at the back of the vertebræ, chiefly attached to the discs and margins of the bones. It forms the anterior boundary of the canal.

The **ligamentum subflava** is composed of yellow elastic tissue; it is attached to the front and lower border of one lamina, and to the back and upper border of the lamina of the vertebræ next below. It is very strong and elastic, and helps to maintain the curvatures of the spine, and assists the muscles in recovering the erect position after the spine has been bent forward.

Interspinous ligaments between margins of spinous processes, strongly developed in the lumbar region.

Inter-transverse ligaments between transverse processes.

Two sets of ligaments bind the ribs to the vertebræ; one set connects the heads of the ribs to the bodies of the vertebræ, the other connects the necks and tubercles with the transverse processes.

There are anterior, posterior, and capsular ligaments connecting the costal cartilages with the sternum.

The clavicle and sternum are bound together by an anterior and posterior, capsular, and other ligaments.

The sterno-clavicular joint has two synovial membranes.

The sacro-iliac-synchondrosis has five strong ligaments:

1. **Anterior sacro-iliac.**
2. **Posterior sacro-iliac.**
3. **Oblique sacro-iliac.**
4. **Great sacro-sciatic.**
5. **Small sacro-sciatic.**

The **great sacro-sciatic ligament** crosses the great sacro-sciatic notch, leaving a hole, the great sacro-sciatic foramen, through which pass out of the pelvis the pyriformis muscle, above it the gluteal vessels and superior gluteal nerve, and below it the sciatic vessels and nerves, internal pudic vessels and nerve, and the muscular branches of the sacral plexus.

The **small sacro-sciatic ligament** crosses from the spine of the ischium to the sacrum, and closes in the lesser sacro-sciatic notch, leaving a hole through which the internal obturator muscle and the internal pudic vessels and nerve pass out.

The symphysis pubis has four ligaments:

1. **Anterior pubic.**
2. **Posterior pubic.**
3. **Supra-pubic.**
4. **Infra-pubic.**

MUSCLES.

The upper limb is attached to the back of the trunk by five muscles, the trapezius and the latissimus dorsi, which are attached to the scapula and to the humerus, and cover nearly all the back from the occiput to the ilium. Underneath the trapezius are the two rhomboid muscles, and the levator anguli scapulæ. The latissimus dorsi, with the teres major, form the *posterior* fold of the axilla. The pectoralis major, which extends from the anterior aspect of the sternum to the pectoral ridge of the bicipital groove of the humerus, forms, with the lower border of the pectoralis minor, the *anterior* fold of the axilla. These two muscles and the subclavius and serratus magnus attach the upper limb to the front of the trunk.

There are five layers of muscles on the back. The first two, as above mentioned, are connected with and act on the upper limb.

Of the third layer, two are muscles of respiration. The third keeps the head erect.

The fourth layer is composed of the erector spinæ and its continuations, the long extensors of the back, extending from sacrum to occiput. They keep the back erect.

The fifth layer is composed of many small muscles, lying in the groove between the lateral and spinous processes, the entire length of the column.

The front of the abdomen is closed in by five pairs of muscles; in the middle are two recti, which are parallel to the middle line, with the two pyramidales at their lower end. At the sides are the external oblique, the fibres of which run downward and forward; the internal oblique immediately

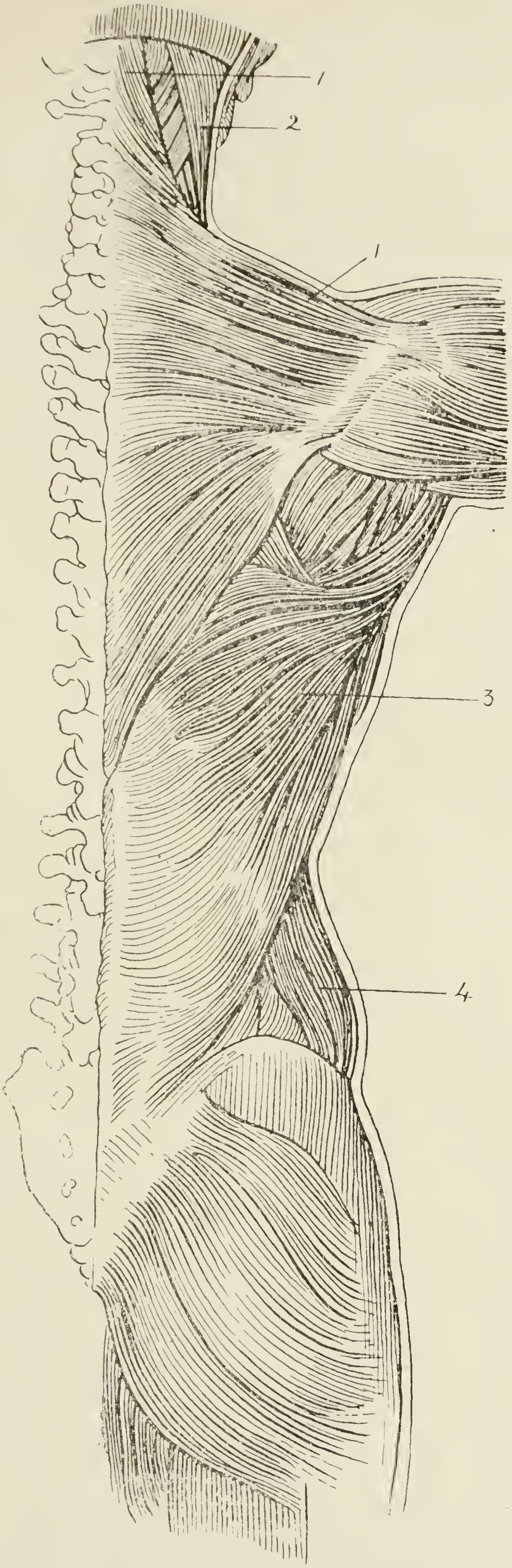

Fig. 69.—Superficial Muscles of the Back.

1, Trapezius; 2, sterno-mastoid; 3, latissimus dorsi; 4, external oblique.

under the external—its fibres run upward and forward ; and the transversalis under the internal oblique—its fibres run across. This arrangement of the fibres gives strength to the abdominal walls.

These three muscles become tendinous towards the middle, and unite with their fellows of the opposite side, forming an incomplete sheath for the recti muscles. A fibrous band is formed in the middle line by their union, reaching down from the ensiform cartilage to the pubes ; it is called the linea alba.

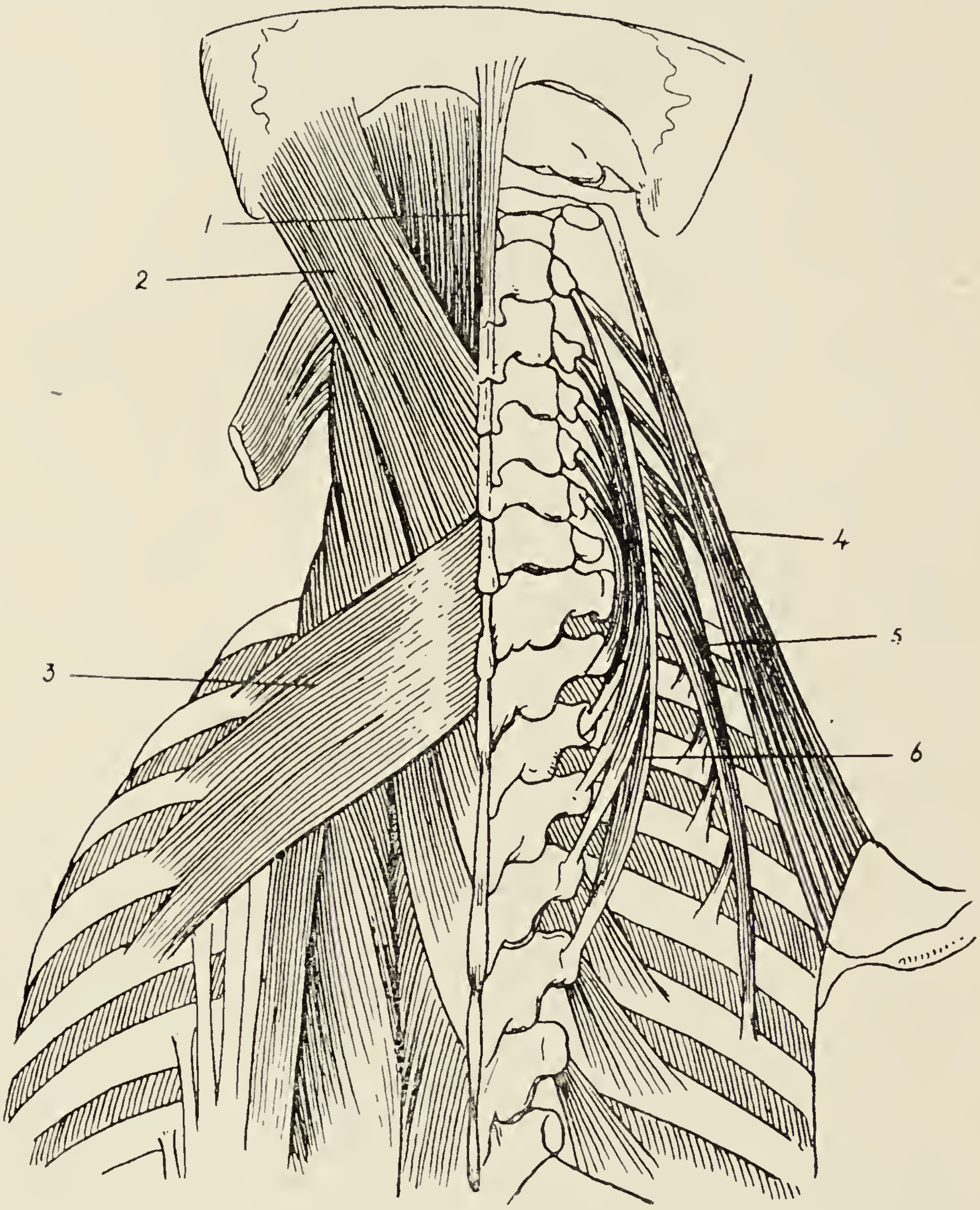

FIG. 70.—DEEP MUSCLES OF THE UPPER PART OF THE BACK.
1, Serratus posticus superior ; 2, splenius ; 3, complexus ; 4, levator scapulæ ; 5, cervicalis ascendens ; 6, transversalis cervicis.

The thickened lower border of the external oblique muscle is folded back on itself, and forms **Poupart's ligament.** It is attached to the anterior superior spine of the ilium and to the pubis. The lower border joins the fascia lata of the thigh.

The round depressed cicatrix between the ensiform cartilage and the pubis, nearer to the latter, is the **umbilicus.**

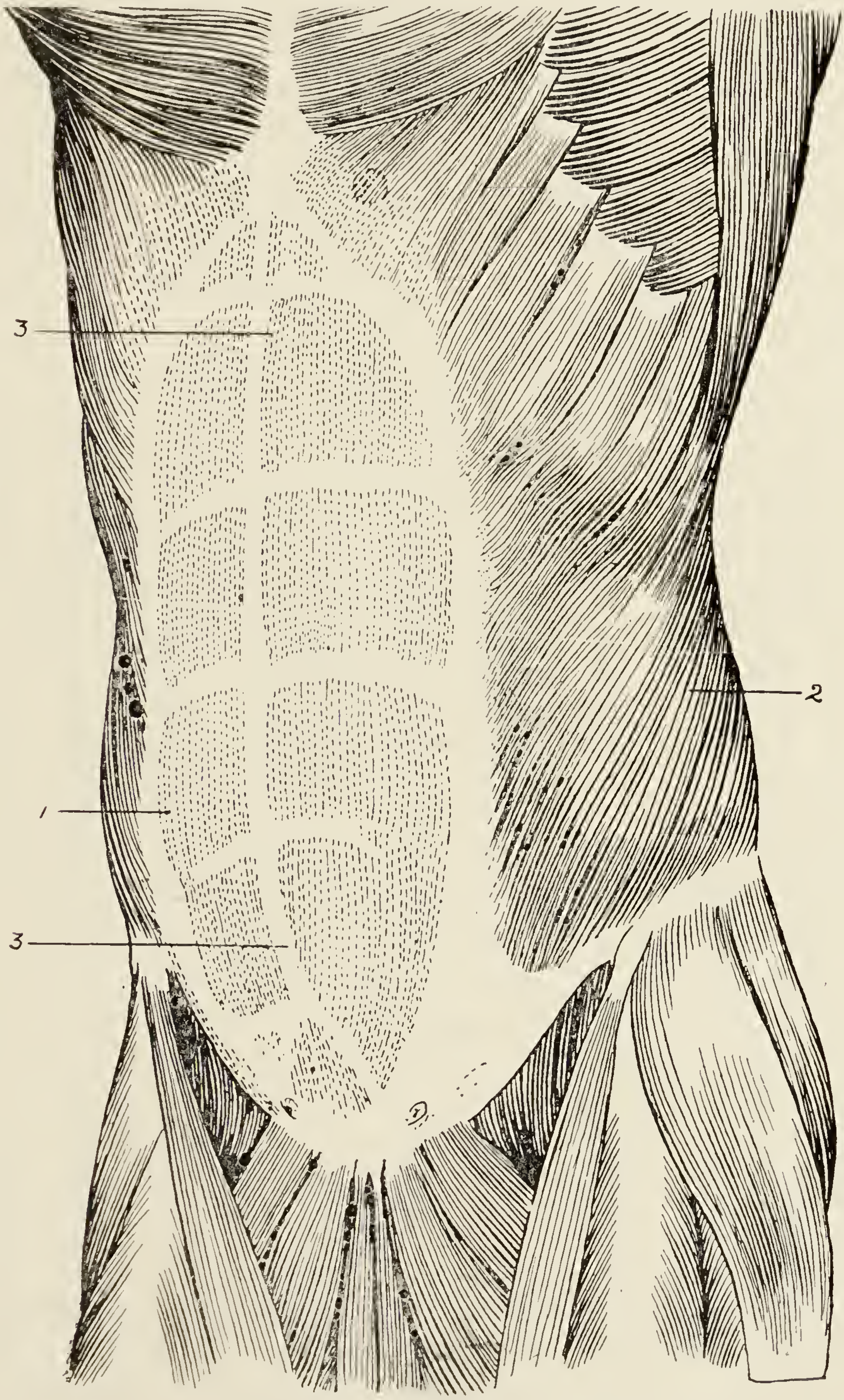

FIG. 71.—SUPERFICIAL MUSCLES OF THE ABDOMEN.

1, Rectus abdominis; 2, external oblique; 3, linea alba.

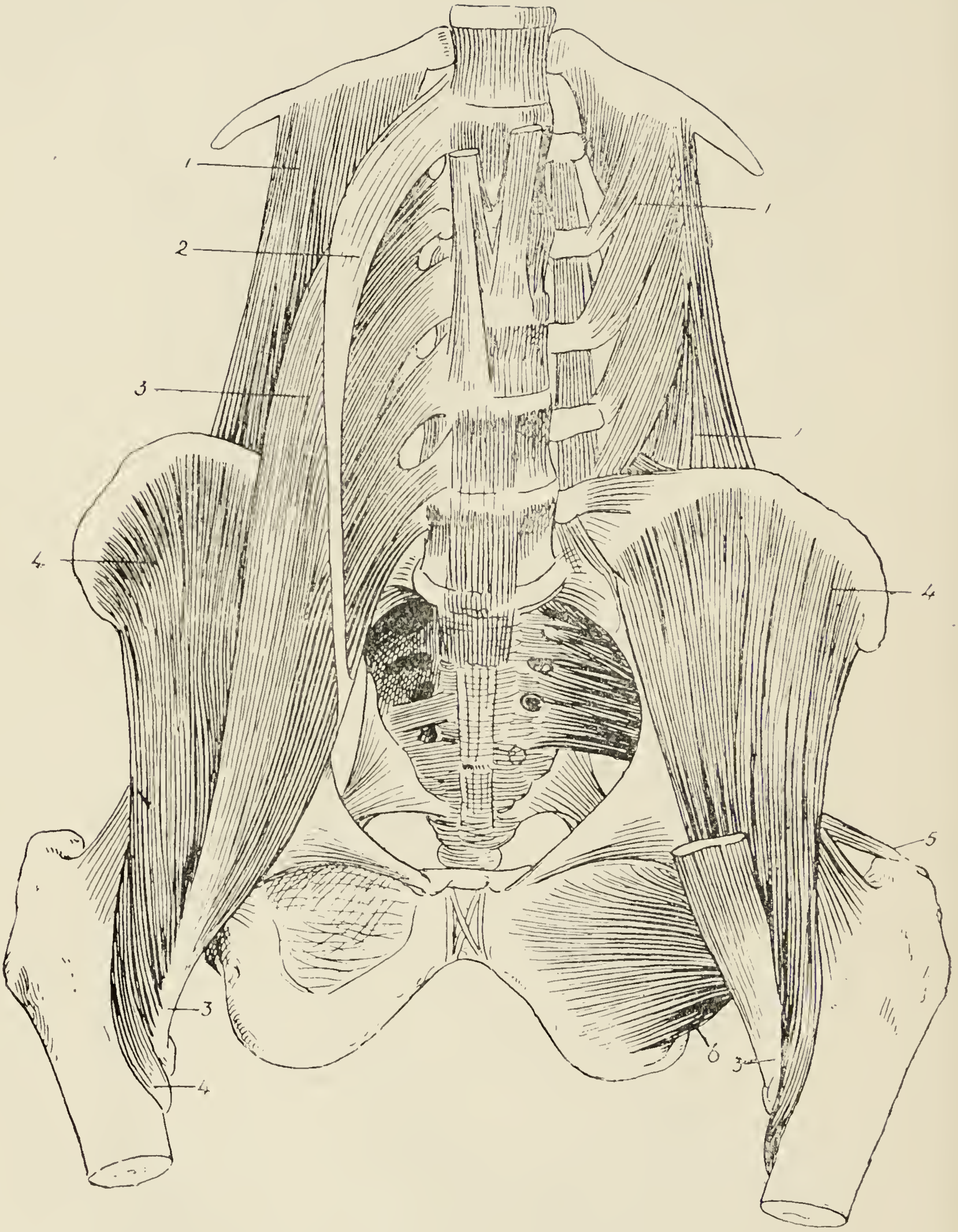

FIG. 72.—MUSCLES OF THE PELVIS.

1, Quadratus lumborum; 2, psoas parvus; 3, psoas magnus; 4, iliacus; 5, pyriformis; 6, obturator externus.

MUSCLES OF THE BACK.

Name.	Origin.	Insertion.	Action.	Nerve Supply.	
Trapezius.	Occipital protuberance, ligamentum nuchæ, spines of last cervical and all dorsal vertebræ, supra spinous ligament.	Outer end clavicle. Acromion process, outer end spine scapula.	Moves shoulder up and back, elevates arm, bends neck back and sideways.	Spinal accessory. Nerves from cervical plexus.	First layer.
Latissimus dorsi.	Crest of ilium, sacral, lumbar and six lower dorsal spines, lower angle scapula, three or four lower ribs, supraspinous ligament.	Lower part inner ridge bicipital groove of humerus.	Draws arm back and down.	Long subscapularis.	
Levator anguli scapulæ.	Transverse processes, four upper cervical vertebræ.	Vertebral border scapula, from upper angle spine.	Raises upper angle of scapula.	Cervical plexus, fifth cervical nerve.	Second layer.
Rhomboid minor.	Lower part ligamentum nuchæ, seventh cervical and first dorsal spines.	Root of spine of scapula.	Draws lower angle of scapula back and up.	Fifth cervical.	

MUSCLES OF THE BACK—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.	
Rhomboid major.	Four or five upper dorsal spines, supraspinous ligament.	Vertebral border scapula, between spine and lower angle.	Draws lower angle of scapula back and up.	Fifth cervical.	Second layer.
Splenius: (1) Capitus. (2) Collis.	Lower half ligamentum nuchæ, last cervical and six upper dorsal spines.	(1) Mastoid process, ridge of occiput. (2) Transverse processes, three upper cervical vertebræ.	(1) Draws head back. (2) Keeps neck erect.	Posterior primary branch cervical and dorsal.	Third layer.
Serratus posticus superior.	Last cervical, two upper dorsal spines, lower part ligamentum nuchæ.	Second, third, fourth, fifth ribs beyond angles.	Raises ribs in inspiration.	Posterior primary branch dorsal.	
Serratus posticus inferior.	Two last dorsal, two upper lumbar spines.	Four lower ribs near their angles.	Draws ribs down in expiration.	Posterior primary branch dorsal.	
Erector spinæ; divides into seven parts:	Crest ilium, posterior iliac spines, nobs of sacrum, sacral, lumbar, three dorsal spines.	Four lower ribs near their angles.	Keeps spine erect.	Posterior primary branch sacral.	Fourth layer.

a. Ilio-costalis or sacro-lumbalis, outer column erector spinæ.	Crest ilium, posterior iliac spines, nobs of sacrum, sacral, lumbar, three dorsal spines.	Angles six or seven lower ribs.	Keeps spine erect.	Posterior branches lumbar and dorsal.	Fourth layer.
b. Musculus accessorius.	Angles six or seven lower ribs internal to ilio-costalis.	Angles six upper ribs.	Keeps spine erect.	Posterior branch dorsal.	
c. Cervicalis ascendens.	Angles four or seven upper ribs.	Tubercles transverse processes, fourth, fifth, sixth cervical vertebræ.	Keeps spine erect.	Posterior branches four lower cervical.	
d. Longissimus dorsi. Middle column erector spinæ.	Angles four or seven upper ribs.	By two series: (1) Transverse processes all lumbar and dorsal vertebræ nine or ten lower ribs. (2) Transverse processes lower cervical.	Keeps spine erect.	Posterior branches lumbar and dorsal.	
e. Transversalis cervicis.	Transverse processes upper dorsal vertebræ.	Transverse processes cervical vertebræ, except first and last.	Keeps spine erect.	Posterior branches dorsal and cervical.	

MUSCLES OF THE BACK—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.	
f. Trachelo mastoid.	Transverse processes upper dorsal and lower cervical vertebræ.	Back of mastoid process.	Steadies head and draws it back.	Posterior branches dorsal and cervical.	Fourth layer.
g. Spinalis dorsi. Inner column erector spinæ.	Two upper lumbar, two lower dorsal spines.	Dorsal spines from four to nine.	Keeps spine erect.	Dorsal.	
Complexus.	Transverse processes seventh cervical, three upper dorsal articular processes, fourth to sixth cervical vertebræ.	Occiput.	Strengthens continuation of erector spinæ in the neck. Draws head back.	Branches of cervical.	
Multifidus spinæ.	Back of sacrum, spine of ilium, lumbar, dorsal cervical vertebræ, sacro-sciatic ligament.	The whole series of spinous processes.	Keeps erect and rotates spinal column.	Posterior branches cervical, dorsal, lumbar, sacral.	Fifth layer.

There are several other small muscles not necessary to note.

MUSCLES OF THE CHEST.

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Pectoralis major.	Sternum, clavicle, seven upper costal cartilages.	Outer margin bicipital groove of humerus.	Draws arm down and forwards. Raises body to arms.	External anterior thoracic.
Pectoralis minor.	Third, fourth and fifth ribs.	Coracoid process scapula.	Depresses point of shoulder.	Internal anterior thoracic.
Serratus magnus.	Eight upper ribs.	Vertebral border of scapula.	Extends arms, raises ribs in inspiration.	Posterior thoracic.
External intercostal, eleven.	Inferior border of ribs.	Superior border of ribs.	Raise ribs in inspiration.	Intercostal.
Internal intercostal, twelve.	Inferior border of ribs.	Superior border of ribs.	Depress ribs in expiration.	Intercostal.
Diaphragm.	Ensiform cartilages, six or seven lower ribs, bodies lumbar vertebræ.	Central tendon.	Respiration and expulsion.	Phrenic.

MUSCLES OF THE ABDOMEN.

Name.	Origin.	Insertion.	Action.	Nerve Supply.
External oblique.	Eight lower ribs.	Linea alba, outer lip iliac crest, ensiform cartilage, pubis.	Compresses viscera. Flexes thorax.	Intercostal. Ilio-hypogastric. Ilio-inguinal.
Internal oblique.	Outer half Poupart's ligament, lumbar aponeurosis, middle lip iliac crest.	Cartilages four lower ribs, ensiform cartilage, linea alba.	Compresses viscera. Flexes thorax.	Intercostal. Ilio-hypogastric. Ilio-inguinal.
Transversalis.	Outer third Poupart's ligament, inner lip iliac crest, cartilages six lower ribs, lumbar vertebræ.	Linea alba, pubis, pectineal line.	Compresses viscera. Flexes thorax.	Intercostal. Ilio-hypogastric. Ilio-inguinal.
Rectus abdominis.	Pubic crest.	Ensiform and fifth to seventh costal cartilages.	Compresses viscera. Flexes thorax.	Intercostal. Ilio-hypogastric. Ilio-inguinal.
Pyramidalis.	Pubic crest.	Linea alba.	Makes tense linea alba.	Ilio-hypogastric.
Quadratus lumborum.	Crest ilium, transverse processes three lumbar vertebræ.	Last rib. Transverse processes of upper four lumbar vertebræ.	Keeps spine straight. Aids in contracting diaphragm. Flexes laterally.	Branches from lower dorsal and upper lumbar.

FASCIA.

The *vertebral* fascia is strong and thin; it confines the muscles of the spine and head in a hollow between the spinous processes of the dorsal vertebræ and the angles of the ribs; it joins the fascia of the neck and the lumbar fascia. The latter is a dense structure which gives support to the lumbar muscles, and origin to the three flat muscles of the abdominal walls. It is in three layers, and encloses the erector spinæ and quadratus lumborum.

The *superficial* fascia of the pectoralis major contains the mammary gland. The deep fascia is thin; it invests the pectoralis major, and is attached to the clavicle and to the front of the sternum. At the lower border of the pectoralis it is continuous with the axillary fascia, which is very dense and stretches across the armpit, and is continuous with the fascia of the serratus magnus and latissimus dorsi.

The *superficial* fascia of the abdomen is continuous with that of the chest. Above it is thin, but becomes dense at the lower part, where it consists of a fatty layer which is continuous with the superficial fascia of the thigh and a membranous layer which blends with the fascia lata of the thigh. The superficial fascia of the abdomen is more elastic than that of the rest of the body, owing to the elastic fibres in its membranaceous part.

The *deep* fascia of the abdomen lines the visceral portion of the deep muscles and the back of the abdominal cavity; it is called the **transversalis fascia** and the **iliac fascia.**

The **trunk** has two chambers separated by a muscle called the **diaphragm**, which is the chief muscle of respiration, and, after the heart, the most important muscle in the body.

Its origin is: *in front*, by fleshy attachment from the back of the ensiform cartilage; *behind*, by two pillars, or crura, from the bodies of the upper three lumbar vertebræ—*laterally*, from the lower six costal cartilages, and interdigitating with the transversalis abdominis. It has three openings:

1. **The aortic.**
2. **The vena-caval.**
3. **The œsophageal.**

Through the aortic pass the aorta, the thoracic duct, and the vena azygos major. Through the vena-caval, the inferior vena cava, and through the œsophageal the œsophagus and the two pneumogastric nerves. There are small openings in the pillars for the passage of the small azygos vein and splanchnic nerves.

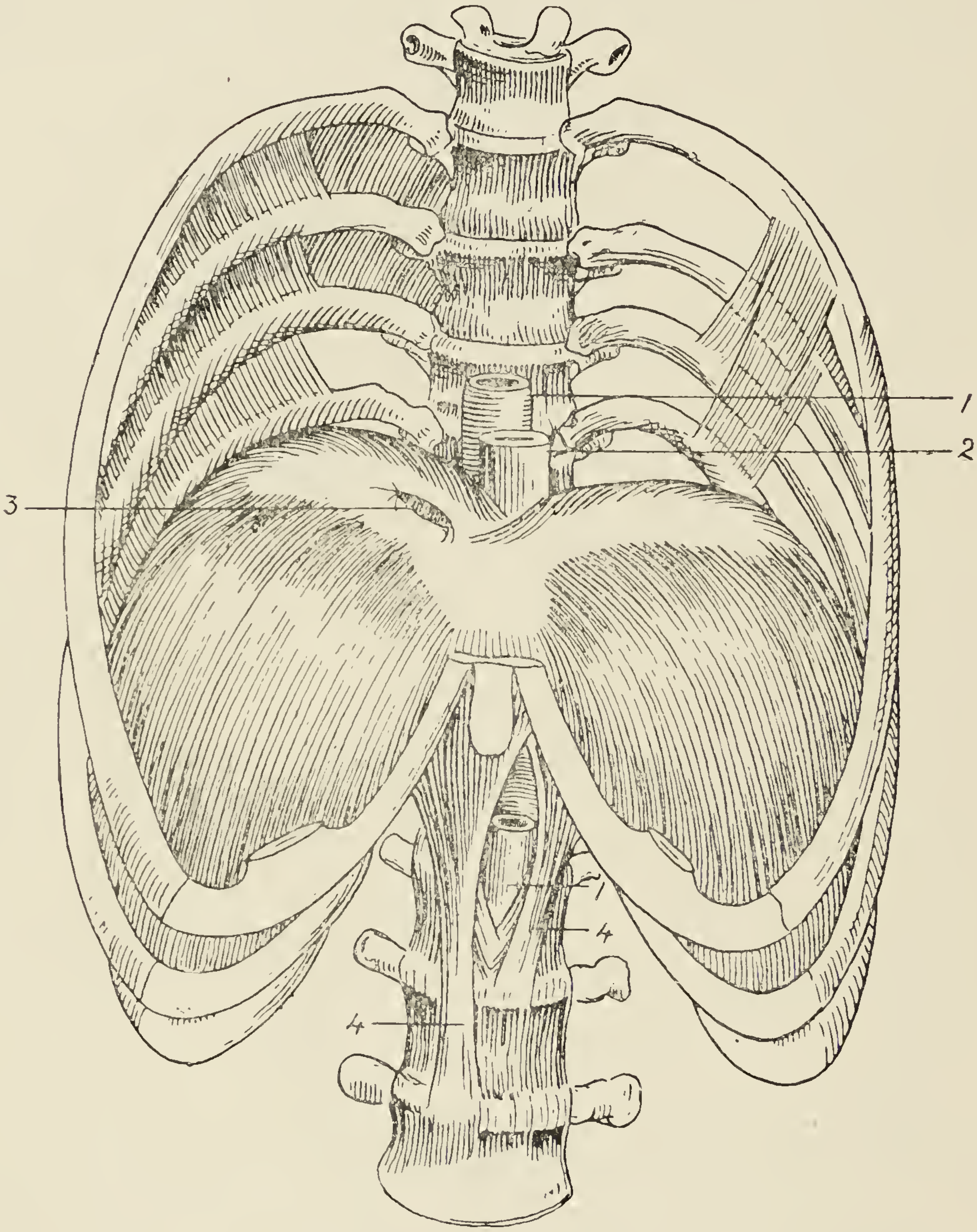

Fig. 73.—Diaphragm.
1, Aorta; 2, œsophagus; 3, opening for inferior vena cava; 4, crus.

The upper chamber of the trunk is the thorax.

The lower chamber is the abdomen.

The **thorax** is a conical flexible case formed by the dorsal vertebræ, the ribs with their cartilages, and the sternum. It contains:

Part of the **trachea, or windpipe.**
,, ,, **lungs.**
,, ,, **heart.**
,, ,, **great bloodvessels.**
,, ,, **œsophagus, or gullet.**
,, ,, **thoracic duct.**

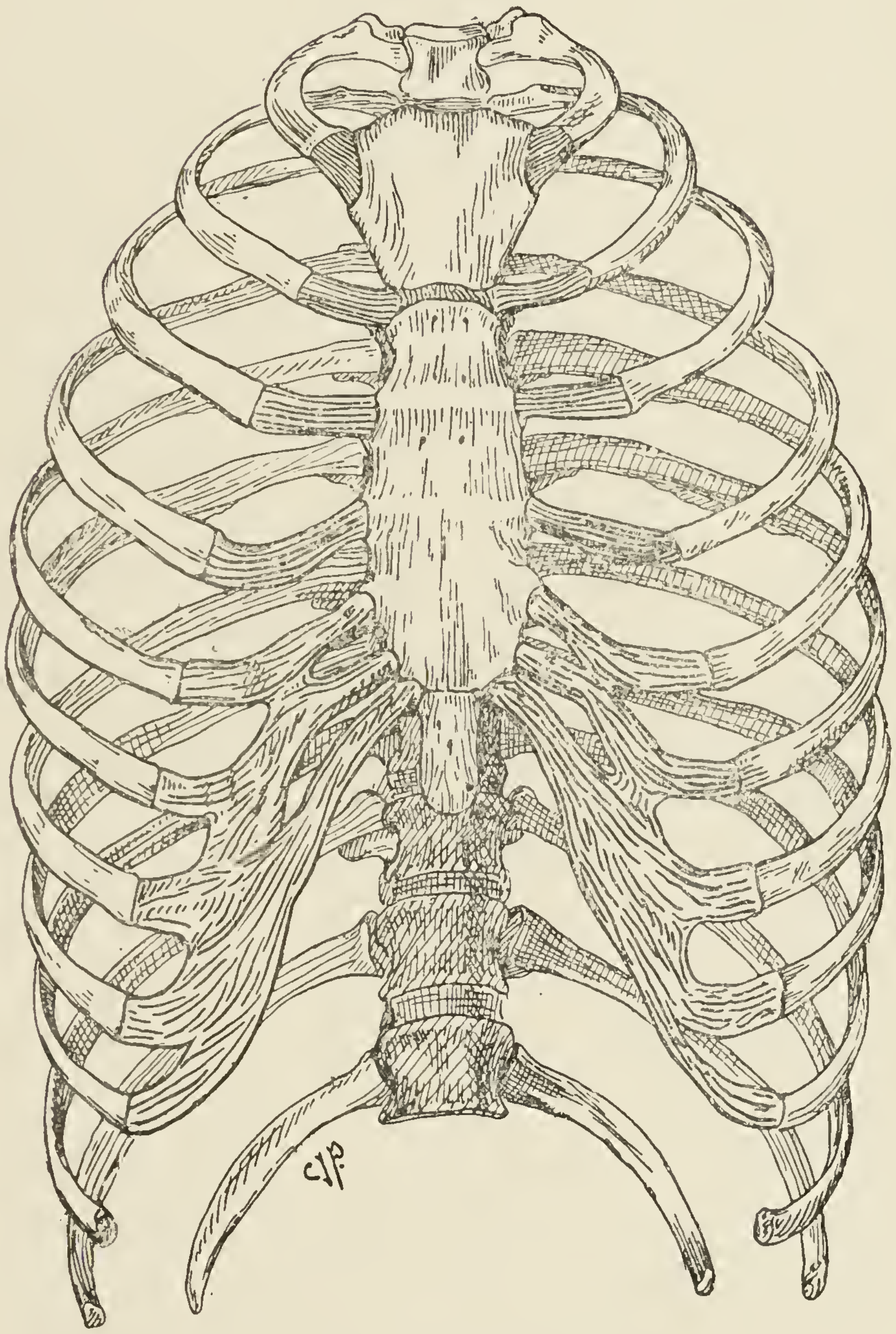

Fig. 74.—Thorax.

The spaces between the ribs are occupied by the internal and external intercostal muscles.

The **trachea**, which is the principal air-tube, $4\frac{1}{2}$ inches long and $\frac{3}{4}$ inch wide, composed of membrane and imperfect rings of cartilage, passes from the throat into the thorax, and divides into the right and left bronchi, which go to the right and left lung respectively ; they divide and subdivide, after the manner of the branches of a tree, till the tubes reach every part of the lungs. The smaller tubes have no cartilages, but have coats of unstriped muscle which contract ; the ends of the tubes terminate in sacs, the walls of which are covered with saccular dilations, the air-cells or alveoli.

These air-cells are the special respiratory parts of the lungs. The capillaries from the pulmonary artery form a close network around them ; the blood in the capillaries comes almost in contact with the inspired air, having only the thin walls of the air-cells and capillaries between. The air-passages are lined with epithelium, and from the surfaces of the epithelial cells delicate filaments called cilia project, which, with a wavelike movement, send forward mucus with dust and other particles breathed in with the air, thus keeping the lungs comparatively free from foreign matter.

The **lungs** are two spongy organs quite distinct from each other, placed on either side of the middle line. A large portion of them is occupied by the bronchial tubes and the air-cells in which they terminate, otherwise they are made up of numerous bloodvessels, lymphatics and nerves bound together by connective tissue.

Each lung is enclosed in a serous sac—the pleura, one layer of which is attached to the walls of the chest and diaphragm ; the other closely covers the lungs. The sacs are moistened by a serous secretion, so that the surfaces in contact can move easily on each other during the movements of respiration. The apices of the lungs rise about an inch and a half above the clavicle, passing upwards through the thoracic inlet into the root of the neck. The base of each lung rests on the diaphragm ; the right lung is shorter than the left, as the diaphragm rises higher on the right side owing to the position of the liver. The left lung is narrower than the right, owing to the position of the heart. The base of the right lung rests on the right lobe of the liver ; the base of the left lung is in relation to the left lobe, the stomach and the spleen, the diaphragm being between. The right lung has three lobes, the left has two.

On the inner border of each lung, nearer to the apex than to the base, is the root; it is formed by the bronchial tubes, pulmonary arteries, pulmonary veins, nerves and lymphatics, held together by an investment of the pleura, which there enter by the hilum, a slit on the inner surface, and connect the lungs with the heart and trachea.

Respiration is carried on by means of the

- **Mouth.**
- **Nose.**
- **Larynx.**
- **Trachea.**
- **Bronchi.**
- **Lungs.**

An adult breathes from sixteen to eighteen times per minute, and breathes more frequently when moving or even standing than when lying down. At every inspiration the cavity of the chest is enlarged in every direction. From above downwards by the contraction and depression of the diaphragm, and transversely by the raising of the ribs. The air passes in through the trachea to the lungs, expands them, and keeps their sides in contact with the walls of the chest, and their bases in contact with the diaphragm.

Expiration by expulsion of air diminishes the cavity of the thorax. The expired air is warmer and more moist than the inspired air. It contains carbolic acid and other effete matter. The lungs are never empty; after the most forced expiration some air is still left, and is called residual or stationary air. In ordinary breathing a man takes in about a pint, or 20 to 30 cubic inches of air. This is called tidal air. In forced inspiration more can be taken in, which is called complemental air. The tidal air carries oxygen into the residual air, and takes from it carbonic acid, etc. The air in the vesicles and the blood in the capillaries are separated only by the thin walls of each, so that carbonic acid and other waste matter pass through these thin walls, and are carried off by expiration. Oxygen from the air in the vesicles also passes through these walls, and is taken up by the red corpuscles and carried to the tissues.

Deep breathing aids the flow of blood and of lymph by pressure on the large bloodvessels and thoracic duct.

The **heart** is a hollow muscular organ, situated behind the sternum and costal cartilages, and between the lungs, two-thirds being on the left of the middle line. It is cone-shaped; the base is upwards and backwards, a little below the level of the second costal cartilage; the apex is directed downwards, forwards, and to the left between the fifth and sixth ribs, 2 inches below the nipple. Like the lungs, the heart is enclosed in a double serous membrane, called the pericardium, one layer of which, the *visceral* portion, is closely attached to the heart, and covers the great bloodvessels for about 1½ inches. The *parietal* portion is continuous with and reflected over the *visceral* portion, so that it envelops it and the heart. It secretes a small quantity of serous fluid, the internal surfaces are smooth and polished, and continually glide on each other as the heart contracts.

The interior of the heart is lined by a delicate membrane called the endocardium.

(For cavities, etc., see Chapter III.)

The **œsophagus** passes down the neck, close behind the trachea, into the hinder part of the thorax; it connects the pharynx with the stomach, and extends from the sixth cervical to the tenth or eleventh dorsal vertebra. It corresponds to the cervical and dorsal curves of the spine. It has three coats—an external muscular, an internal mucous, with an areolar coat between. The surface of the mucous coat has numerous papillæ, and is covered by epithelium.

The **thoracic duct** commences in the abdomen, on a level with the second lumbar vertebra, in a dilatation called the receptaculum chyli. It enters the thorax on the right side of the aorta, through the same opening in the diaphragm; it passes up in front of the vertebral column, and out through the thoracic inlet; it inclines to the left, and ascends to the seventh cervical vertebra, when it arches outwards and downwards, and joins the internal jugular vein at its junction with the subclavian vein.

ARTERIES.

The part of the aorta which is contained within the thorax is named the *ascending aorta*, the *arch of the aorta*, and the *descending thoracic aorta*.

The *visceral* branches of the descending thoracic aorta supply the lungs, pericardium, œsophagus and posterior mediastinal.

The *parietal* branches are the intercostal. They run outward over the bodies of the vertebræ, under the gangliated cord of the sympathetic, one in each of the nine lower intercostal spaces. Each artery is accompanied by a nerve and a vein. They run along the borders of the ribs, a posterior branch divides into a spinal branch to the cord and a muscular branch.

VEINS.

The **superior vena cava**, which returns to the heart all the venous blood from the upper part of the body, is formed by the union of the two innominate veins behind the first costo-sternal junction of the right side; it proceeds down and opens into the upper part of the right auricle at the upper border of the third cartilage of the right side; it is 3 inches long.

Its tributaries are the azygos major and small pericardiac and mediastinal veins.

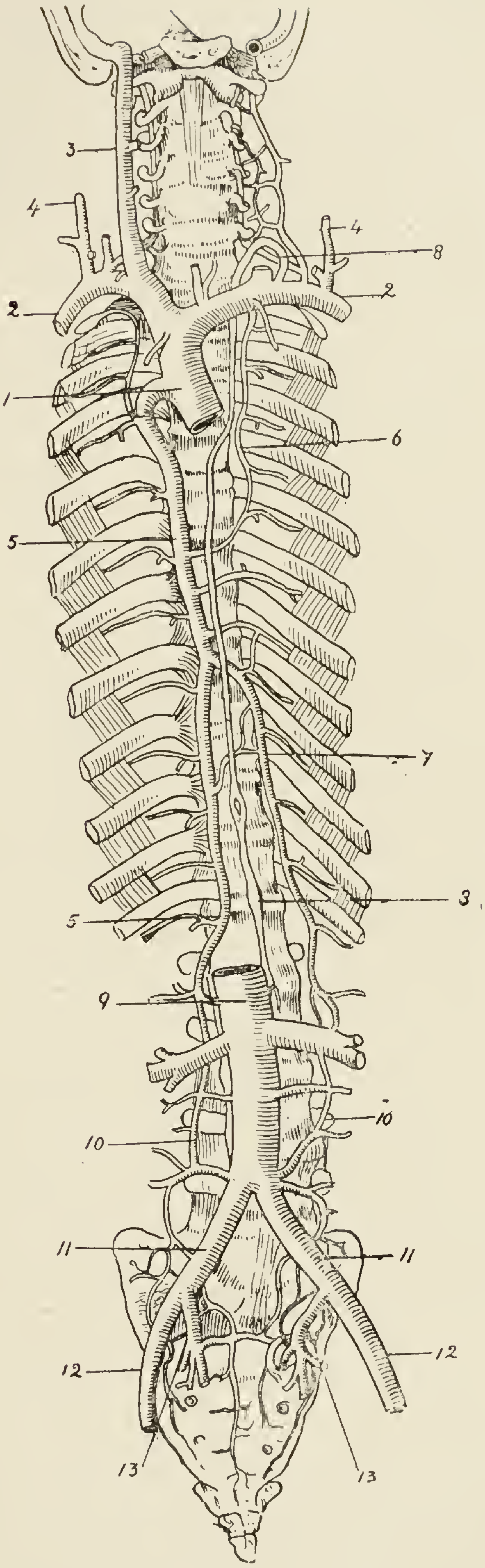

Fig. 75.—Venous Trunks.

1, Superior vena cava; 2, subclavian vein; 3, internal jugular; 4, external jugular; 5, azygos major; 6, azygos minor superior; 7, azygos minor inferior; 8, thoracic duct; 9, internal vena cava; 10, ascending lumbar vein; 11, common iliac; 12, external iliac; 13, internal iliac.

The blood from most of the intercostal veins is received by the azygos veins.

The **azygos major** arises in the abdomen from the ascending lumbar vein on the right side, enters the thorax with the aorta, extends upwards on the bodies of the dorsal vertebræ, and joins the superior vena cava, thus connecting the two venæ cavæ.

The **azygos minor,** *superior*, joins the azygos major at the eighth intercostal space on the left side, and communicates above with the left superior intercostal, which brings the blood from the second and third intercostal veins to the left innominate vein.

The **azygos minor,** *inferior*, arises from the left ascending lumbar vein, and joins the azygos major at the ninth intercostal on the left side.

The **inferior vena cava,** on entering the thorax, immediately passes through the pericardium and opens into the lower and back part of the heart.

LYMPHATICS.

Intercostal glands are on each side of the spine, along the heads of the ribs, which empty into both ducts.

Several glands lie between the sternum and pericardium; several round the great vessels receive the lymphatics of the heart; numerous bronchial glands receive the superficial and deep lymphatics of the lungs. There are ten or twelve posterior mediastinal glands along the œsophagus and aorta.

There are an interior and posterior set of deep lymphatics in the intercostal spaces which go to the internal mammary and intercostal glands respectively.

NERVES.

The **phrenic nerve** is the most important branch of the cervical plexus, as it is the motor nerve of the diaphragm. It enters the thorax behind the subclavian vein; in passing down it gives branches to the pleuræ and pericardium; finally it breaks up into several branches which pierce the diaphragm and spread over its under surface.

The **left pneumogastric** (or vagus) nerve enters the thorax between the carotid and left subclavian arteries; behind the root of the left lung it breaks up into a number of branches, which form the left pulmonary plexus, two cords of which go to the front of the œsophagus and form the plexus gulæ; it then passes out of the thorax by the œsophagal opening in the diaphragm, and breaks up into branches on the anterior surface of the stomach.

The **right pneumogastric** lies deeper in the thorax than the left. It descends by the side of the trachea to the back of the root of the right lung, and breaks up into the right pulmonary plexus, two cords of which assist in forming the plexus gulæ; it leaves the thorax by the same opening as the left, and breaks up into branches on the posterior aspect of the stomach.

The **cardiac plexus** of the sympathetic system is situated on the lower end of the trachea and behind the aortic arch; the nerves which form it are from the cervical ganglia of the sympathetic, from the pneumogastric and from the recurrent laryngeal nerves. The thoracic ganglia of the sympathetic are eleven in number; for the most part they lie on the heads of the ribs. They are continued from the cervical and into the abdominal ganglia.

(For the Splanchnic Nerves, see Chapter IV.)

The intercostal or anterior branches of the dorsal nerves are distributed to the chest and abdomen. They do not unite in plexuses; each one runs separately in a groove in the lower margin of the corresponding rib, and has muscular and cutaneous branches. The dorsal or posterior branches supply the skin and muscles of the back.

CHAPTER VIII

THE TRUNK (*continued*)

The **pelvis** is divided into true and false. The false pelvis is the abdomen proper, the part that is enclosed in front only by muscle and fascia. The true pelvis, or pelvic cavity, is the part which is bounded in front by the pubes, the upper surface of which is the brim. The ridge is called the ilio-pectineal line. The abdomen proper is in a nearly straight line from the thorax. The pelvic cavity goes very distinctly backwards.

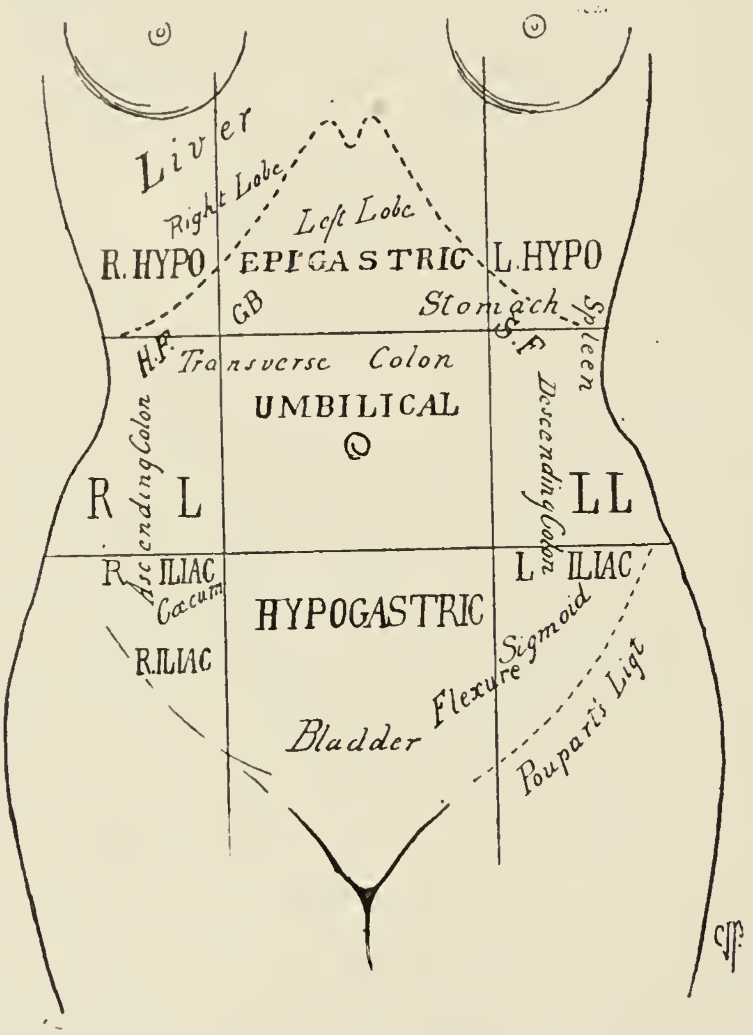

Fig. 76.—Nine Divisions of the Abdomen. Approximate Position of the Organs.

The **abdomen** is further divided into nine regions by four imaginary lines, two horizontal and two vertical. The horizontal are supposed to pass (1) from the lowest part of the tenth costal arch on one side to the corresponding spot on the opposite side; (2) from the highest point of one iliac crest to the other. The vertical are parallel with the middle line of the body, from a point midway between the symphysis pubes and the highest point of the ilium, passing upwards to the breasts.

In the upper region there are three divisions:

Right and left hypochondriac.
Epigastric in the middle.

In the middle region there are three divisions:

Right and left lumbar.
Umbilical in the middle.

In the lower region there are three divisions:

Right and left iliac.
Hypogastric in the middle.

The upper region is called the **costal zone.** The middle region is the **umbilical zone.** The lower region is the **hypogastric zone.**

The contents of the abdomen are the stomach, small and large intestines, liver, with gall-bladder, pancreas, spleen, two kidneys, two suprarenal capsules, two ureters, bladder, receptaculum chyli, abdominal aorta with its branches, inferior vena cava with its tributaries, plexuses of nerves (spinal and sympathetic), and lymphatic glands and vessels.

The **stomach** is a muscular and membranous bag, situated one-fourth in the epigastric region, about 2½ inches below the ensiform cartilage, and three-fourths in the left hypochondriac region; it is about 10 inches long from right to left, and is curved on itself, so that the lower surface is long and convex, and the upper short and concave. They are called the greater and lesser curvatures. The opening from the œsophagus is the cardiac orifice; the lower opening into the first part of the small intestine is the pyloric orifice.

The stomach has five coats; the inner three are continuations of the coats of the œsophagus. The mucous membrane is drawn up into folds when the stomach is empty; it contains

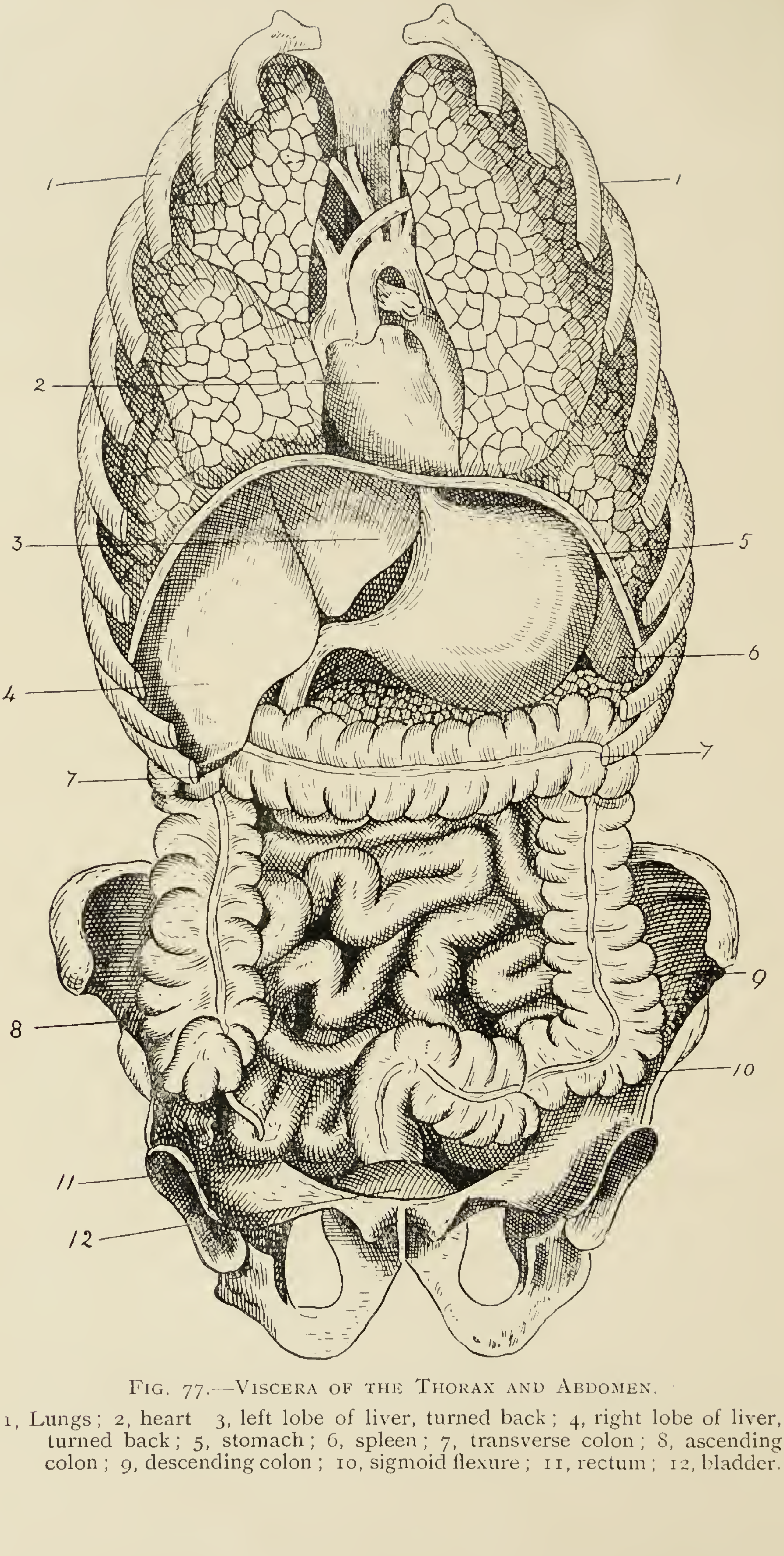

FIG. 77.—VISCERA OF THE THORAX AND ABDOMEN.

1, Lungs; 2, heart 3, left lobe of liver, turned back; 4, right lobe of liver, turned back; 5, stomach; 6, spleen; 7, transverse colon; 8, ascending colon; 9, descending colon; 10, sigmoid flexure; 11, rectum; 12, bladder.

numberless small glands which secrete mucus, which keeps the surface moist.

The small intestine is divided into three parts:

1. **Duodenum.**
2. **Jejunum.**
3. **Ilium.**

There is no real division between these; altogether they are about 20 feet in length, and are coiled in the middle of the abdomen. The **ilium** opens into the larger intestine. This opening is guarded by a fold of mucous membrane called the **ilio-cæcal valve.** The large intestine is about 6 feet long; it lies on outer sides, and in front of the small intestine; it is also divided into three parts. The divisions are as follows:

Cæcum.
1. **Ascending colon.**
Hepatic flexure.
2. **Transverse colon.**
Splenic flexure.
3. **Descending colon.**
Sigmoid flexure.
Rectum.

The **cæcum**, a short, blind pouch, lies in the right iliac fossa. At the back and inner part of the cæcum is a narrow tube from 3 to 6 inches long, called the vermiform appendix.

The **colon**, the second part, extends up through the right lumbar region, and is here called the *ascending* colon. At the under surface of the right lobe of the liver it bends forwards and to the left, and crosses the abdomen, where it is called the *transverse* colon. In the left hypochondrium, near the spleen, it again bends downwards and forward, passing down through the left lumbar region, and is called the *descending* colon; at the anterior spine of the ilium it bends after the manner of an S, and takes the name of the *sigmoid* flexure. The intestine then inclines inwards to the middle line, and descends in front of the sacrum, and is called the *rectum.*

The **rectum** is 6 or 8 inches long; when it reaches the middle of the sacrum it follows the curve of that bone and ends in the anus.

The coats of the intestines are the same in number and name as those of the stomach. In the small intestine the transverse folds of the mucous lining are permanent, and are called valvulæ conniventes; they and the intervals between them are covered with little projections called villi. In the centre of each villus is a lacteal.

The **liver** is the largest gland in the body; it fills the greater part of the right hypochondriac region, extends through the epigastric and slightly into the left hypochondriac region, an inch beyond the left margin of the sternum. It measures about 12 inches from right to left, 6 inches from front to back, and 3 inches vertically at the back of the right lobe. It weighs from 3 to 4 pounds. Its upper surface fits closely into the lower surface of the diaphragm; its lower border at the left side is at about the sixth rib; in the epigastric region it is midway between the ensiform cartilage and the umbilicus, lying partly over the stomach; on the right side it follows the ribs pretty closely, descending about an inch below them in the upright position; on the extreme right it descends as low as the first or second lumbar spine. It has two lobes—right and left; the right lobe is much larger than the left, and has three subdivisions. Four vessels enter and leave the under side of the liver; they are the

Portal vein.
Hepatic artery.
Hepatic vein.
Hepatic duct.

It is supplied with blood by the hepatic artery and the portal vein; the former brings blood from the descending branch of the aorta to nourish the structures of the organ; the latter brings blood which has traversed the capillaries of the stomach, intestines, spleen and pancreas, and is laden with the products of digestion. In the liver the portal vein breaks up, after the manner of an artery, into smaller veins, and these again into capillaries, which form a close network between the cells of the liver.

The capillaries of the liver unite to form small veins, which form larger ones that terminate in the hepatic vein, and by it the blood is carried to the inferior vena cava.

The **pancreas** is an elongated gland lying across the posterior wall of the abdomen, behind the stomach, on a level with the first lumbar vertebra, one end in contact with the spleen, the other with the duodenum. It is about 7 inches long, 2 inches wide, and weighs about 3 ounces.

The **spleen** is a ductless gland, lying for the most part in the left hypochondrium, but its upper end extends into the epigastric region. It is behind the stomach; it is parallel with and follows the curve of the ninth, tenth and eleventh ribs, its backward extremity pointing to and not far from the spinal column. Its average size is 5 inches long, 3 and 4 inches broad, and 1½ inches thick. It weighs about 7 ounces. The spleen is the only organ in which the blood comes in contact with the tissue element, the capillaries are not continuous, and the blood is poured into the interstices of the tissues; it is collected by branches of the splenic vein. The functions of the spleen are not thoroughly understood; but it is supposed to have largely to do with the blood corpuscles, both in their formation and destruction.

The **kidneys** are situated opposite to the last dorsal and upper two or three lumbar vertebræ; they lie in the hypochondriac and epigastric regions, and the right kidney is also slightly in the right lumbar and umbilical region, being rather lower than the left, probably because of the size of the right lobe of the liver. They are each about 4 inches long, 2½ inches wide, 1½ inches thick, and weigh 4½ ounces. The left is slightly longer and narrower than the right.

On the concave side there is a longitudinal depression, called the **hilum**, through which bloodvessels, nerves, lymphatics and ducts pass in and out.

All the tissues and organs and the circulatory blood contain urea, which is the product of the nitrogenous waste of the body; the kidneys take up this urea from the blood; dissolved in water it, with other nitrogenous extracts and salt, forms the urine, which passes through the ureters to the bladder, and from thence is ejected from the body by the urethra. The renal artery supplies blood to the kidneys direct from the aorta. The blood returned by the renal vein is still bright red, being purified in the kidney.

The **kidneys** are embedded in loose areolar tissue, which contains much fat.

The **suprarenal capsules** are two small bodies which surmount the kidneys like helmets; their use is not very well understood.

The **ureters** are muscular ducts, about 15 inches long, and the size of a pencil. They extend downwards and inwards, and at each side pierce the base of the bladder obliquely about 1½ inches apart. The obliquity of their entrance prevents a backward flow of urine. The urine is taken through the ureters partly by gravity and partly by peristaltic contractions, which travel from above downwards.

The **bladder** is a strong, hollow, muscular organ, where the urine collects before it leaves the body; when empty, it lies within the pelvis, behind the pubes; when moderately distended, it becomes oval, and rises above the brim of the pelvis; and when over-distended, it rises even to the umbilical region.

The **urethra** is a short canal, about 1½ inches long in the female, which extends from the bladder to the external orifice.

The bladder, urethra and rectum are in the true pelvis.

In the female pelvis, between the rectum and the bladder, is situated the **uterus**.

The **ovaries** are two small bodies contained within a fold of peritoneum called the broad ligament. They lie immediately below the external iliac vessels on the posterior part of the side wall of the pelvis.

Peritoneum.—The peritoneum is a serous membrane which lines the walls of the abdominal cavity and invests nearly all its viscera. The kidneys and ureters are outside the peritoneum. The part which lines the walls is called *parietal*, that which is reflected on the organs *visceral*, peritoneum. It facilitates the movements of the digestive organs by affording a smooth lubricated surface upon which they can glide on one another. A fold of the peritoneum which connects the stomach with other viscera is called *omentum;* a fold which connects the intestinal tube with the posterior walls of the abdomen is called the mesentery; folds which connect viscera which are not parts of the intestinal canal to the walls of the abdomen, or viscera of any kind to the diaphragm, are called ligaments.

The **great omentum**, also called gastro-colic omentum, is the largest fold. It invests the stomach and connects it with the transverse colon; it hangs down from the stomach over the coils of the small intestines like an apron.

The small or *gastro-hepatic* omentum is a fold which connects the stomach with the liver.

The *gastro-splenic* omentum is a fold which connects the stomach with the spleen.

The **mesentery proper** is in connection with the small intestines attaching it to the wall of the abdomen, and enclosing the bloodvessel and nerves.

The mesenteries of the large intestine are the *transverse mesocolon*, *sigmoid mesocolon*, and the *mesorectum*.

THE ALIMENTARY CANAL.

The alimentary canal consists of the

Mouth.
Pharynx.
Œsophagus.
Stomach.
Small intestine.
Large intestine.

Secretions from various glands are poured into it, by which digestion of food takes place.

The food taken in at the mouth and masticated by the teeth is at the same time mixed with saliva, which is secreted by three large glands, the *parotid*, *submaxillary*, *sublingual*.

The parotid lies under and in front of the ear at the angle of the lower jaw; its duct passes through the cheek, and opens into the mouth opposite the second molar tooth.

The submaxillary lies under the angle of the jaw.

The sublingual lies under the tongue. The ducts of these glands open under the tongue in front of the mouth.

There are also numbers of small glands in the mucous membrane which lines the mouth, which secrete a glairy fluid called mucus, which mixes with the saliva.

Saliva is watery; it moistens the food and facilitates swallowing. It contains a substance called ptyalin, which converts the starch in the food, which is insoluble, into sugar, which is soluble and readily absorbed.

In the act of swallowing, the bolus of food passes into the pharynx, a muscular and membranous bag which lies behind the nose, mouth, and larynx.

Beside the opening into the œsophagus, the pharynx has two connecting with the nose, two with the ears, one with the mouth, and one with the larynx; it is about 4½ inches long, and extends from the base of the cranium to the œsophagus. By muscular contractions the food is pushed onward and downwards through the œsophagus, its passage being facilitated by mucus, which is secreted by glands in the inner coat, which is a mucous membrane drawn up into longitudinal folds. The outer coat is thick and muscular; between the two and uniting them is a middle coat of areolar tissue.

The food passes into the stomach through the cardiac orifice. The chief secretion of the stomach is gastric juice secreted by the gastric or peptic glands, and which is poured out during digestion.

Gastric juice is a colourless fluid containing two ferments: pepsin and rennet ferment, hydrochloric acid and salt. It converts the proteids into peptones. Peptones dissolve in water, and thus are readily absorbed by the bloodvessels in the mucous membrane. Water, salts, and sugar are also absorbed by the bloodvessels and by the mucous membrane. Gastric juice dissolves the connective tissue which binds the fat-cells together. It is an antiseptic, and neutralizes the action of the swallowed saliva. It mixes with the food, which undergoes a sort of churning process; by contraction and relaxation of the muscle fibres in the coats of the stomach, it is squeezed and turned round till it becomes a thick soup-like fluid, which is called chyme. The average time occupied in producing this change is two to four hours. The ejection from the pylorus begins in about two hours. The pylorus is kept closed at first by a circular muscle, which slowly relaxes and allows the contents of the stomach to pass into the duodenum. It is now a mixture of digested, partly digested, and undigested food; some of the starch has been turned into sugar, and some of the proteids into peptones, and the fat-cells have been set free. Further digestion of all these takes place in the intestines by the secretions of two glands, which are poured into the duodenum. They are the liver and pancreas.

From the blood brought by the portal vein, the liver manufactures bile and glycogen. **Bile** is being continually secreted, but it flows into the intestines only during digestion; at other times it is stored in the gall-bladder, a pear-shaped sac which lies in a depression on the under surface of the right lobe of the liver; its base comes below the anterior edge. Two ducts—the right and left hepatic ducts—from the right and left lobes, convey the bile from the liver. They unite to form the hepatic duct, which is joined by the cystic duct from the gall-bladder, the union of which gives rise to the common bile duct, which opens into the duodenum.

In the intestines bile excites peristaltic action, and is a natural purgative; it assists in the emulsification and absorption of fats; it neutralizes the gastric juice preparatory to the pancreatic action, and though not absolutely antiseptic, it retards putrefaction. From 30 to 40 ounces are secreted daily.

The other important function of the liver is the formation of **glycogen.** This substance is similar in its nature to starch, and is produced mainly, though not entirely, from the various starchy and sugary elements of the food which have been absorbed and carried to the liver by the portal vein. It is in itself insoluble, but under the influence of some ferment it is readily converted into soluble grape-sugar. It is stored in the cells of the liver, and carried away in small quantities when wanted by the blood. It supplies heat and energy to the body.

The **pancreatic duct**, which carries the secretion of the pancreas to the intestines, joins the common bile duct and enters by the same orifice. The pancreatic juice is the main digestive fluid; it contains three ferments—amylopsin, trypsin, and steapsin—which act respectively on starch, proteids, and fat; so it combines the action of all the other digestive fluids. Saliva acts only on starch, gastric juice on proteids, bile slightly on fats; the pancreatic juice acts on all, turning starch into sugar, proteids into peptones, and emulsifies fat, so that all the food that passes unchanged into the intestines is there digested and the products absorbed, the fats by the lacteals and the remainder by the bloodvessels. The intestines secrete a fluid called succus entericus, which completes the action of the other juices. In the small intestine the chyme is turned into chyle. All that has not been absorbed in the small intestine is urged on through the cæcum into the large intestine, return being prevented by the ilio-cæcal valve. Absorption is continued, and the contents of the colon become more and more solid till they are ejected from the body.

ARTERIES.

At the fourth lumbar vertebra the abdominal aorta divides into the common iliac arteries; opposite the lumbo-sacral joint they divide into the external and internal iliac arteries. The external is the beginning of the main artery which supplies the lower limbs as above described. The internal goes to supply the pelvic organs, etc.

The branches of the abdominal aorta supply all the abdominal organs, and are named from them.

VEINS.

The inferior vena cava is formed at the fifth lumbar vertebra by the union of the common iliac veins, and by its tributaries collects all the venous blood from the lower limbs, the abdominal viscera and part of the abdominal walls; it passes through the vena-caval opening in the diaphragm to open into the lower part of the back of the right auricle.

DEEP LYMPHATIC GLANDS.

There are chains of glands in relation to the iliac arteries, aorta and inferior vena cava, which resolve themselves into four or five trunks, and join the receptaculum chyli, the dilated commencement of the thoracic duct, which is placed in front of the second lumbar vertebræ. The mesenteric glands are very numerous. They are about the size of a pea or bean, and are scattered between the two layers of the mesentery, the larger ones in relation to the superior mesenteric artery, and the others between its branches. There are over a hundred.

The gangliated cord of the sympathetic system extends downwards upon the bodies of the lumbar vertebræ, and in front of the sacrum, and ends in a small ganglion, which unites the two cords in front of the coccyx. There is a plexus on each sacral vertebra connected by twigs with the spinal nerves.

For the solar and hypogastric plexuses and the splanchnic nerves, see Chapter IV.

MASSAGE OF THE CHEST.

The operator may stand at either side, facing the patient.

1. The hands are placed on the chest, spread out over the pectoral muscles, the ends of the fingers on the top of the humerus. They should be drawn towards the middle line, turning at the same time on their own axis, so that on the sternum the fingers point to the chin; they are then drawn down, and once more turned, with fingers outward, under the breasts and over the ribs to the back. They are then brought back in exactly the same way till the finger-tips are on the shoulder (five times).

2. The thumbs are placed at each side of the top of the sternum between the first two ribs, and drawn outwards to the axilla with good pressure over the intercostal muscles. To be repeated between as many ribs as possible.

3. Both hands are laid flat on the chest, thumbs parallel in the centre, fingers pointing to chin, friction with whole hands.

4. With hands in same position, but stationary, the patient takes a deep breath, drawn in through the nose, raising the ribs against the pressure of the hands. Or the hands may be placed under the breasts, the fingers towards the back, and the thumbs end to end on the lower part of the sternum.

For children with narrow or depressed chests artificial respiration movements are useful. Standing at the head of the couch, the arms are grasped above the elbows, and drawn up at each side of the head to full length, then carried back to the body, folded and pressed against the sides and chest.

Outward circumduction of the arms is also good.

The Breasts.—Much relief is given to breasts over-burdened with milk by gentle manipulations.

1. Gentle pressure with cushions of fingers from outer circumference to the nipple, going over all the breast.

2. The same movement with palms of hands, working also in both cases in the armpit.

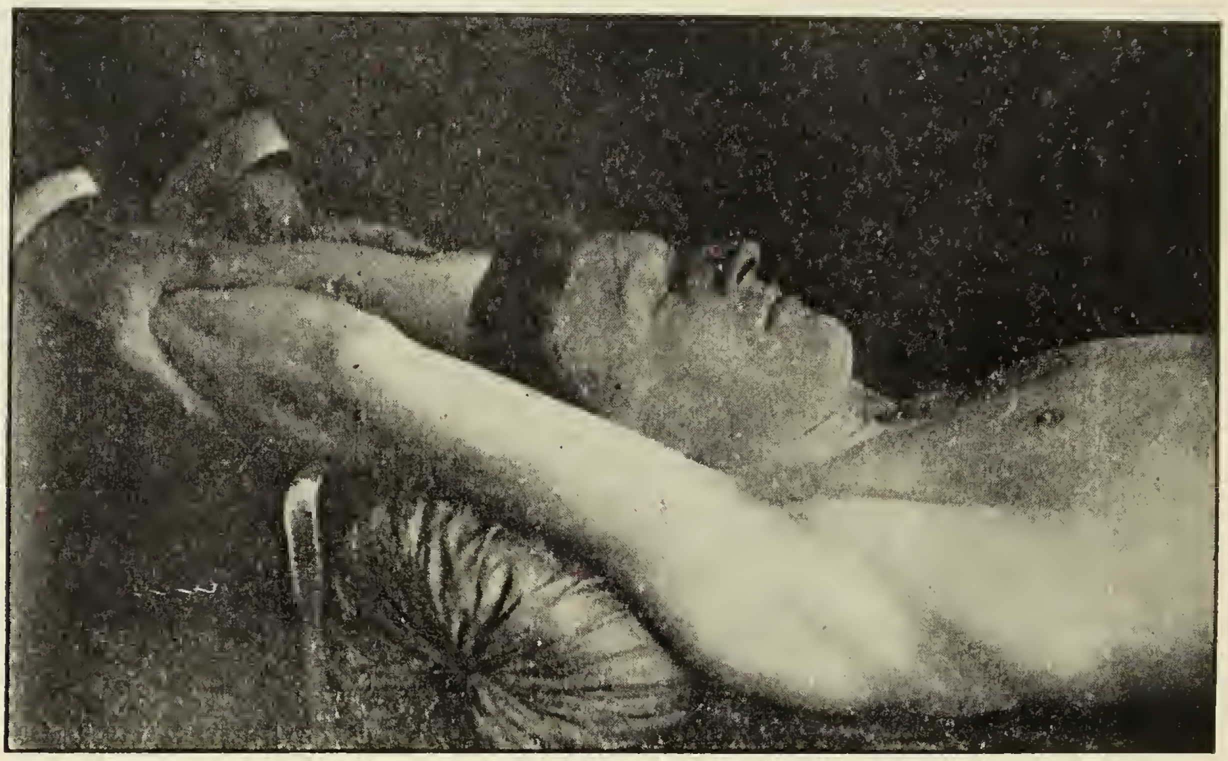

Fig. 78.—Artificial Respiration.

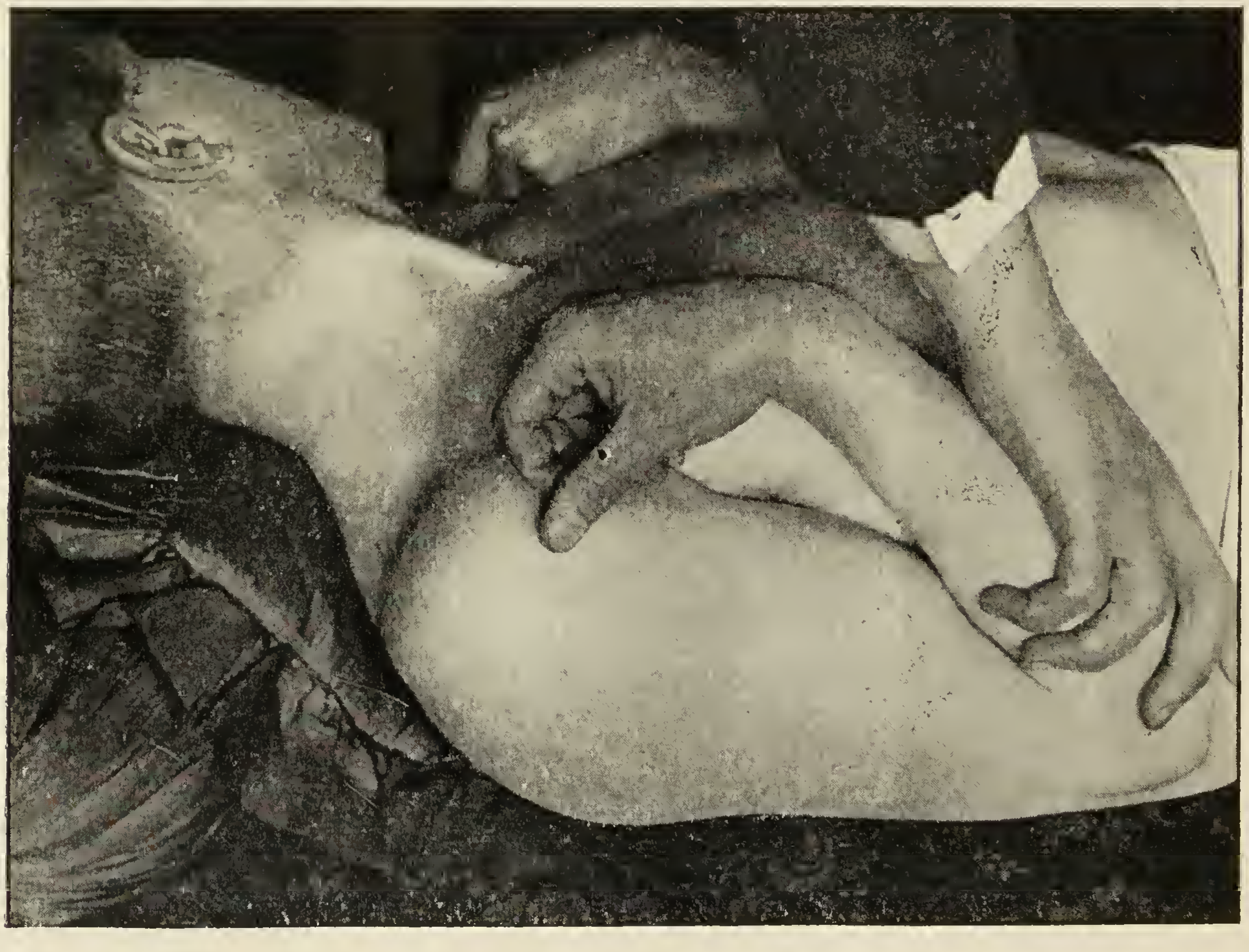

Fig. 79.—Artificial Respiration.

3. Circular movements with one finger over hard or knotty spots to relieve the over-distended ducts.

4. The breast is taken between the two hands, and encircled by them with gentle equal pressure.

The Abdomen.—Massage of the abdomen can be done equally well standing at the right or left side of the abdomen. It is of advantage to the pupil to practise at both sides.

The patient lies on her back, with shoulders raised and knees drawn up, to relax the walls of the abdomen. If the patient is weak, and finds it an effort to keep her knees up, a pillow may be placed under the thighs for support. The arms should lie at the sides, a little away from the body.

Generally the first effect of manipulations of the abdomen is to cause the patient to hold her breath and stiffen the abdominal muscles. If told to breathe naturally, she immediately breathes abnormally. A good plan is to ask a question, and engage her in conversation, then the breathing becomes natural, and the muscles relax.

The Liver.—1. Firm friction all over the region of the liver with whole palmar surface of hand, first placed over the epigastrium and encroaching on left hypochondrium, then moved over right hypochondrium.

2. Kneading with heel of hand over same region.

3. Thumbs placed end to end below and somewhat under tenth rib, a to and fro sawing movement is made from right to left and left to right, following the curve of the ribs and costal cartilages, carrying the flesh with the thumbs, the better to make pressure directly on the liver and gall-bladder. This movement may be done with the ulnar border of the hand, or with the base of the hand.

4. The patient is turned on the left side, that the liver may be reached from behind, where friction and kneading are repeated.

5. Tapotement with ulnar border of closed hand over the whole region of the liver. Hacking may be added.

It is permissible to work in a jerky manner over the liver. Vibrations with palm of hand may be used when suitable.

The Stomach.—1. The thumb of the right hand is placed lengthwise and obliquely in the Λ-shaped space between the

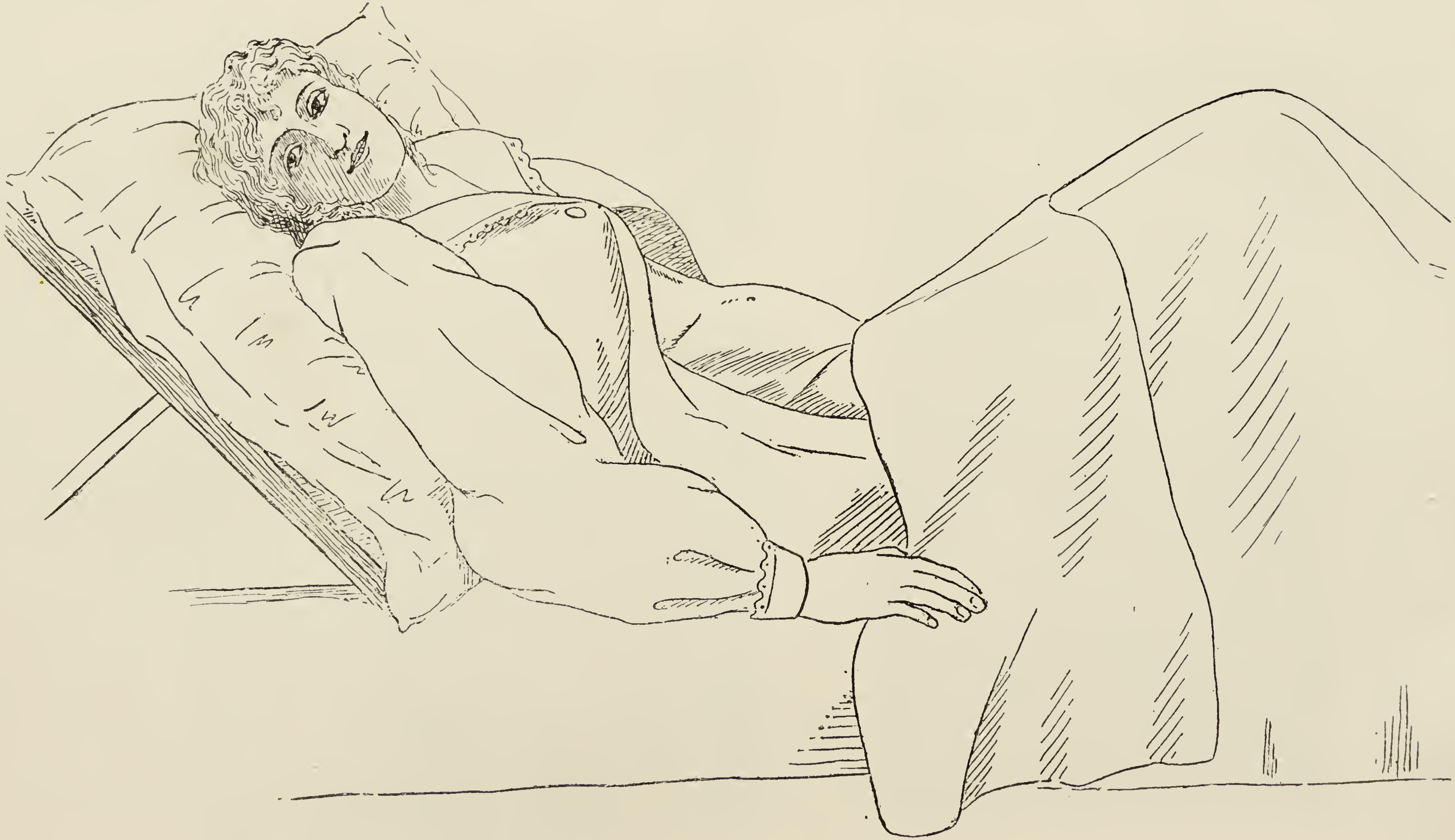

Fig. 80.—Position in Abdominal Massage.

ribs, and between the sternum and umbilicus the fingers are spread out towards the spleen. A movement partly kneading, partly friction, is made with the whole hand, but working more

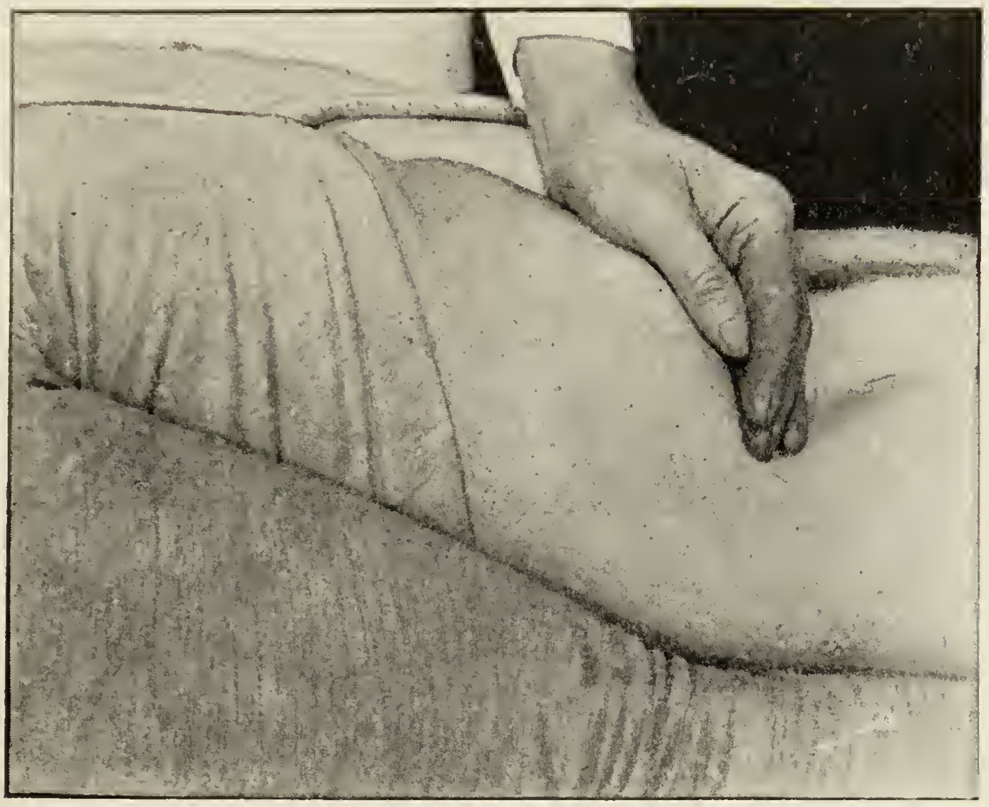

FIG. 81.—KNEADING THE LIVER WITH THE ULNAR BORDER OF THE HAND.

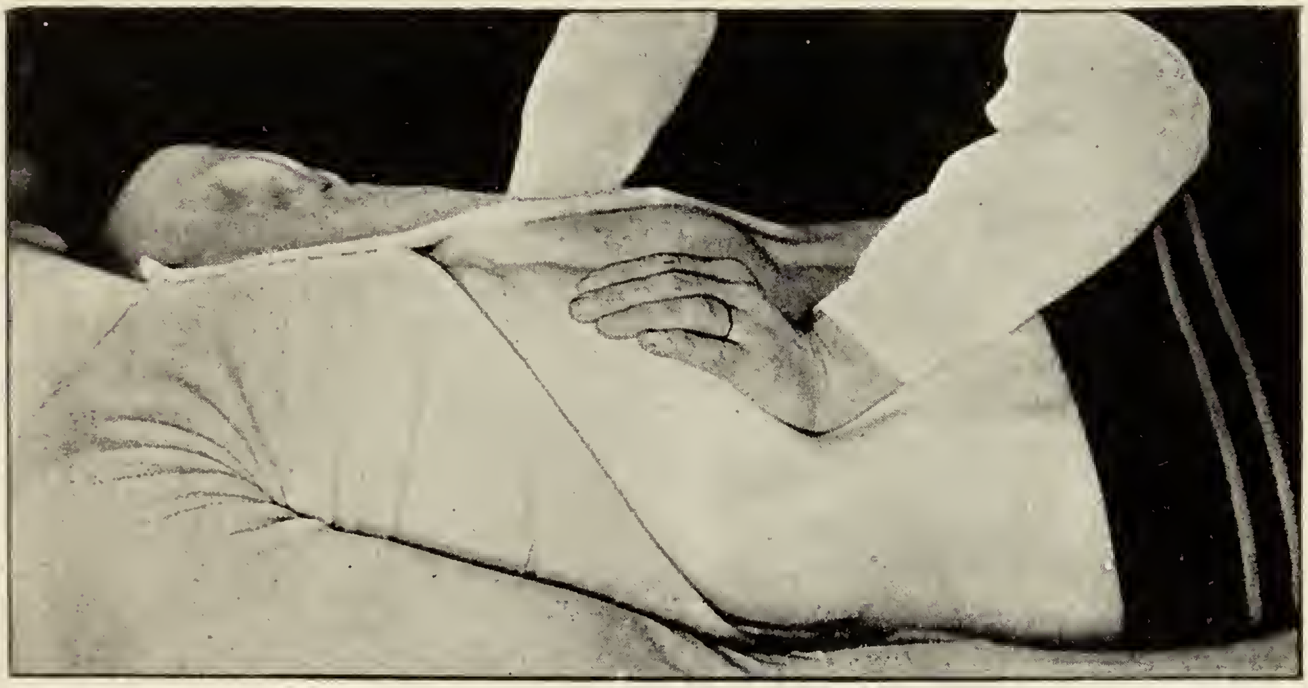

FIG. 82.—KNEADING THE LIVER WITH THE BASE OF THE HAND.

deeply on the soft part with the ball of the thumb, pressure being made towards the pylorus.

2. Kneading with ends of fingers, one hand on the other

over same region, following the curve of the costal cartilages, and working into the ∧ space.

3. Fingers of both hands meet under patient's body, and are drawn upwards and forwards with good pressure till they meet in front, thus compressing liver and stomach. A shaking movement may be given at the same time if thought necessary.

4. Tapping with outspread fingers.

Movements for constipation.—Before the manipulations are commenced, the fingers should be passed gently over the abdomen, and any inequality of the surface, hardness or tenderness, noticed. Accumulation of fæces may be found at some point of the colon.

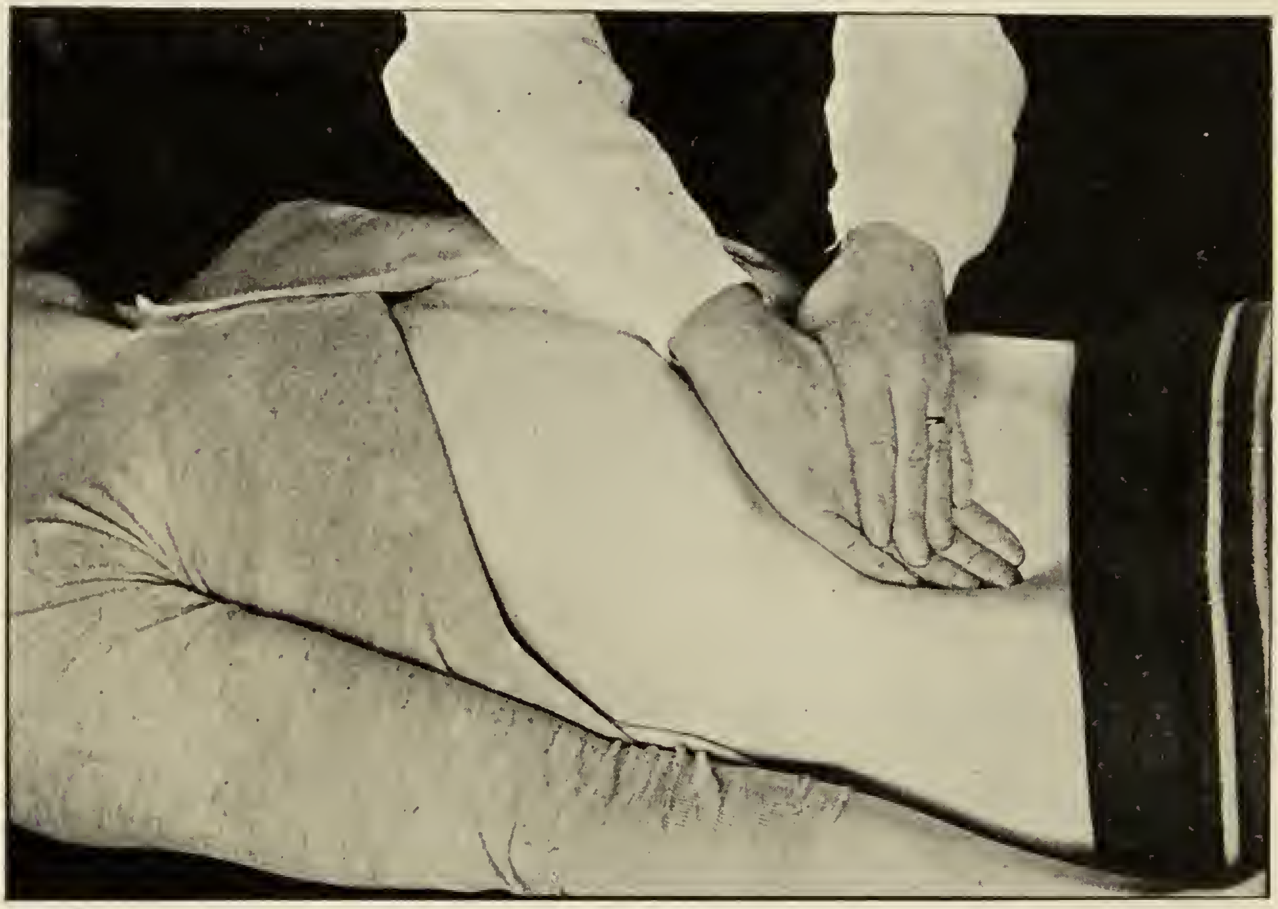

FIG. 83.—KNEADING THE COLON WITH THE FINGERS.

1. Standing so as to look across the patient, the muscles are kneaded with thumbs and fingers.

2. Facing the patient, the finger-tips are placed in a circle around the umbilicus, intermittent pressure is made several times, while a trembling movement is conveyed to the fingers.

3. The thumb is fixed, and the fingers are drawn rapidly, one after the other, in a circle round the umbilicus.

4. Kneading with the ball of the thumb round the same circle, then in the same way round a larger circle.

The Colon.—1. The same movement is done over the colon, beginning at the cæcum, up the ascending colon, across the transverse, down the descending and to the middle line; pressure upwards on the ascending colon, outward on the transverse, downward on the descending to the sigmoid flexure, and inward and upwards to the middle line; special attention is paid to the flexures.

2. Place the heel of the right hand at the beginning of the descending colon, the heel of the left hand at the beginning of the ascending colon; the left hand is moved upwards to the ribs and then across the abdomen, while the right hand is moved downwards to the sigmoid flexure, and inwards to the middle line (Laisne's method).

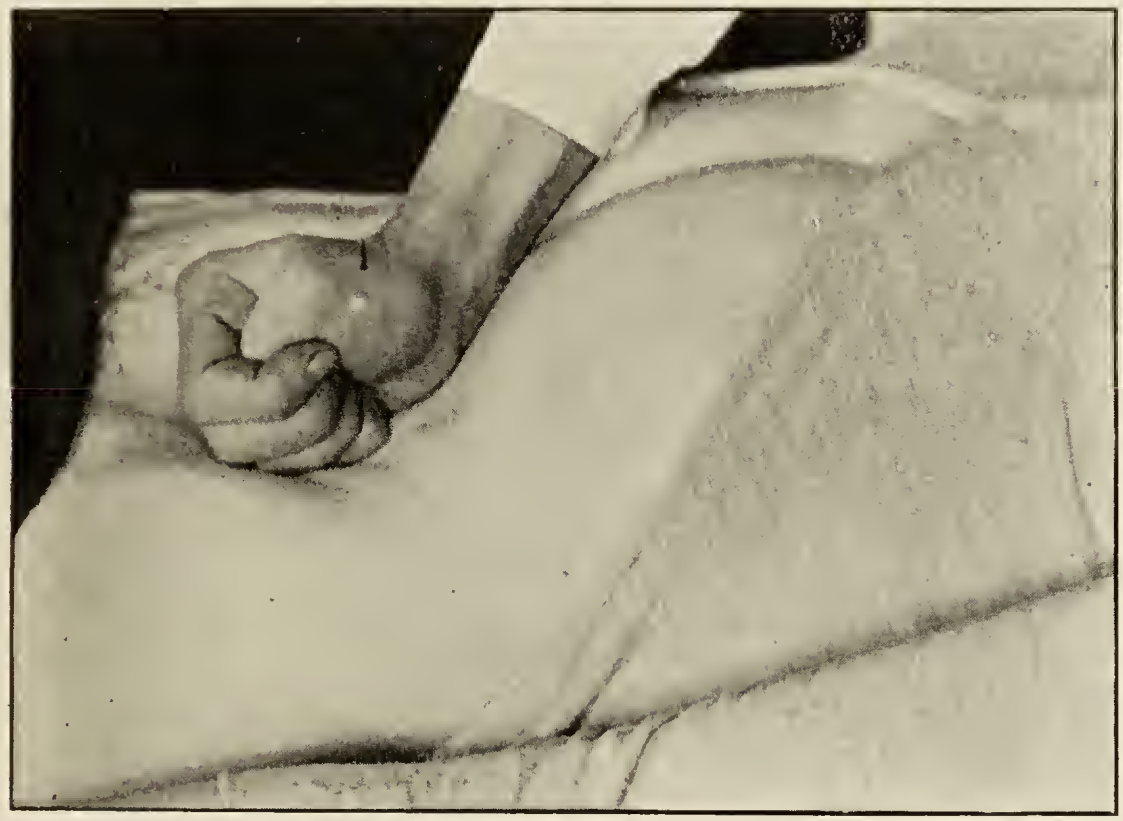

Fig. 84.—Kneading the Colon with the Closed Hand.

3. Kneading with fingers from cæcum all round the colon, deeply, with a wave-like motion.

4. The same, but with closed hand.

5. Beating over the colon.

6. Kneading all the walls with fingers and thumbs, same as No. 1.

7. Beating over sacrum.

If the colon is loaded, it is well to begin the manipulations at the left side over the sigmoid flexure, and to work backwards to the cæcum, pressure being made in the right direction.

If a lump is found, gentle and careful manipulations are made on and about it. If it be fæces, it will be broken up and moved onward. If it remain unchanged, it should be avoided till the doctor sees the patient.

If there are tender places in any part of the abdomen, they should be avoided at first, and afterwards gradually approached. They generally disappear, and the parts can be freely handled, but if the tenderness increases or vomiting sets in, massage must be stopped.

Great care must be used in abdominal massage when there is a movable kidney. The region of the kidney had better be avoided.

Exercises.—1. Flexion of thighs on abdomen.

2. Circumduction of thighs.

3. The body to be raised from the supine to a sitting position without aid of arms.

4. Deep breathing.

Chronic Diarrhœa.—The movements used in chronic diarrhœa are the same as those used for constipation, but not so deep. The object in both cases is to restore tone, to increase nutrition, to aid digestion, and to promote absorption. When food is passed too quickly after eating, and in consequence undigested, benefit is derived from massage of liver and stomach for ten minutes a short time before meals.

When the food is retained too long in the stomach, giving a sensation of fulness and weight, massage of stomach for ten minutes shortly after meals gives relief.

Otherwise, an hour and a half or two hours should elapse after a meal before abdominal massage is given.

The bladder should always be emptied before massage of the abdomen.

The Ovaries.—Massage is ordered over the region of the ovaries and uterus to assist in breaking down adhesions, and sometimes to relieve pain.

The knees are drawn up, but the shoulders are not raised.

The operator's back is to the patient.

1. The patient breathes deeply, and while expiring the ulnar border of the hand (the right for the right side, and the left for the left) is placed just within the iliac spine, palm inwards, the fingers to the pubis and pressed down; another deep breath, and the hand is pressed still further down. A to and fro movement is then made from spine to pubis backwards and forwards.

2. A rotary movement, hands in same position. This movement may also be done with cushions of fingers.

The Uterus. — Pressure can be made on the uterus by spanning the hand across just above the crest of the pubes, the fingers on one side and the thumb on the other; draw all towards centre, relax and repeat. Deep breathing.

Exercises.—1. Abduction of knees.

2. Circumduction of thighs.

The Catamenia.—Abdominal massage must be discontinued while the catamenia are present.

In general massage, if the patient has habitually a normal flow, and little or no pain, no notice need be taken of the event beyond omitting to manipulate the abdomen and the thighs.

Should the patient be accustomed to have a profuse flow, massage should be discontinued for two or three days, then resumed as above.

Should the patient have a scanty flow, or should it be retarded, it is unnecessary to avoid the abdomen and the thighs. Flexion and circumduction of thighs should be added.

Massage of the abdomen:

1. Stimulates liver and gall bladder.
2. Aids digestion in stomach and intestines.
3. Relieves constipation by increasing peristaltic action.
4. Promotes absorption of fluid, and elimination by the kidneys in ascites.
5. Causes absorption of fat deposits.
6. Strengthens weak and relaxed abdominal muscles.
7. Breaks down adhesions.
8. Mechanically moves on contents of colon.

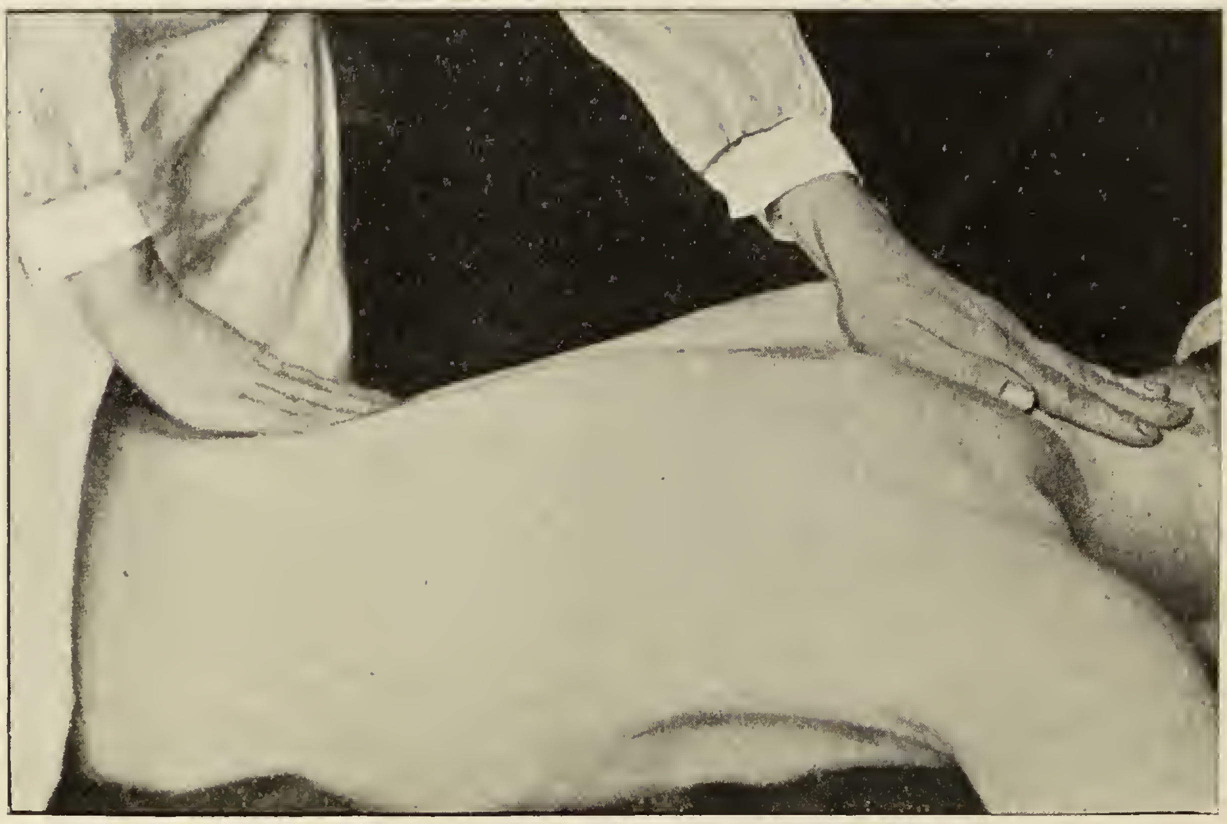

Fig. 85.—Effleurage on the Spine.

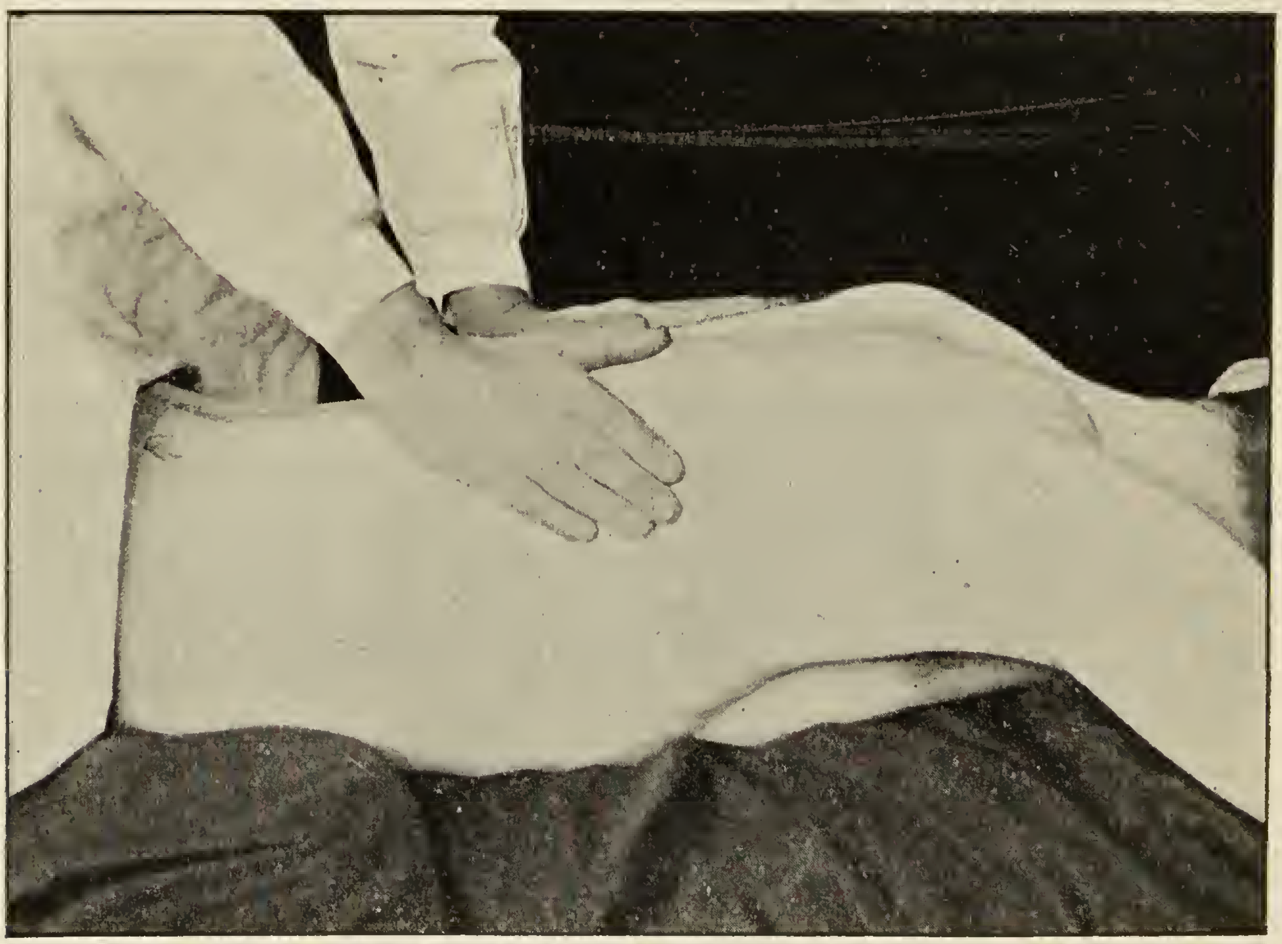

Fig. 86.—Kneading Outwards from the Spine with the Palms.

MASSAGE OF THE BACK.

The patient lies face downward if possible. Some patients cannot, for one reason or another, assume this position ; others have a rooted objection to do so. In such cases the patient must lie first on one side, then on the other, that the whole back may be well masséed. Then, again, the only position possible is sitting and leaning forward, as in phthisis and heart trouble; the disadvantage in this is that the muscles are stretched and cannot be so well kneaded. A flannel jacket put on with the opening at the back covers the chest and arms. The operator may stand at either side.

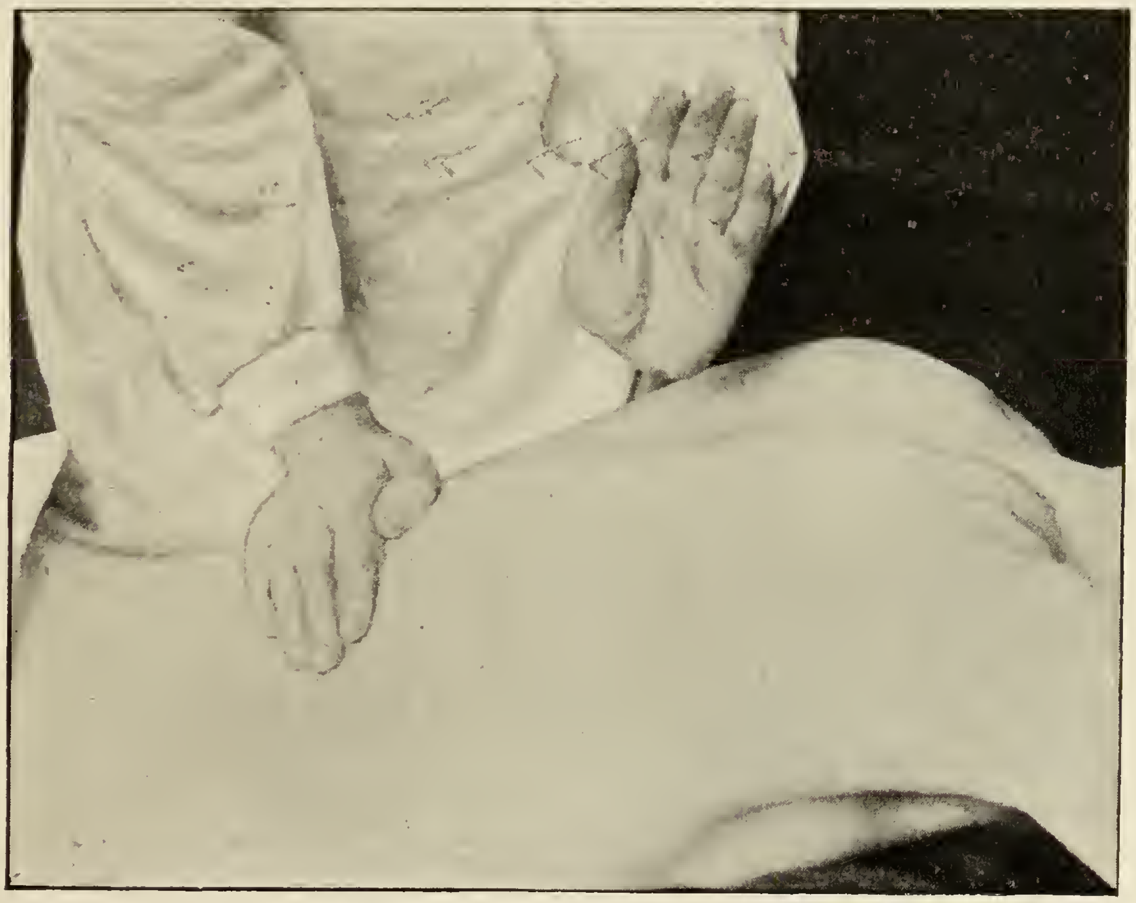

FIG. 87.—CLAPPING.

Supposing the patient to be in the typical prone position, with elbows out and hands under forehead, or with arms straight by sides, palms turned upwards :

1. Effleurage with one hand rapidly from nape of neck to sacrum on spinal column (twenty times).

2. The same with two hands, one following the other.

3. The thumbs are placed at each side of upper part of the column lengthwise, the fingers spread out over the back ;

pressure with thumbs towards fingers, drawing muscles out from middle line. To be repeated several times before moving the hands, and continued to the pelvis.

4. Kneading with heel of hand outward from the spine all over the back, following the muscle fibres.
5. Hacking.
6. Flail.
7. Clapping.
8. Rolling effleurage, pressure downwards from the neck to the armpits, and upwards from the waist to the armpits, following lymphatics to maxillary glands.

For the lower part of back, the upper part to be covered:

1. Effleurage over sacrum.
2. Kneading glutei with thumbs and fingers.
3. Ditto with heel of hand.
4. Hacking.
5. Beating.

CHAPTER IX

THE HEAD, FACE, AND NECK

THE bones of the head and face are called the skull. It is divided into the cranium and face. In the cranium are eight bones:

1 **Frontal** (forehead).	1 **Occipital** (back of head).
2 **Parietal** (sides).	1 **Ethmoid** (sieve).
2 **Temporal** (temples).	1 **Sphenoid** (wedge).

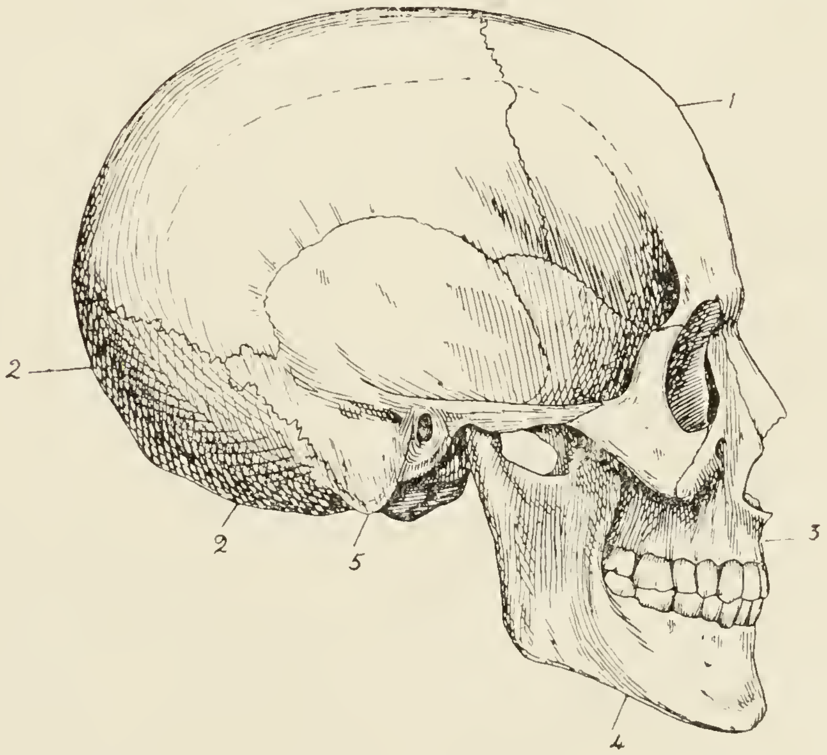

FIG. 88.—1, Frontal bone; 2, occipital bone; 3, upper maxillary; 4, lower maxillary; 5, mastoid process on temporal bone.

The **frontal bone** is the forehead. It forms the upper and fore part of the head, and upper part of the socket of the eye.

The **parietal** are the side walls, which unite and form the arch of the head.

The **temporal** are the lower sides and base. It has an outgrowth of bone forwards called the *zygoma* (an arch formed by the cheek-bones); the *mastoid* process (a protuberance behind the ear), and the cavity for the condyle of the lower jawbone.

The **occipital** forms the back and base of the skull, and lies deeply into the neck. It has a large opening, the foramen magnum, which transmits the spinal cord, spinal accessory nerves, and vertebral arteries. Two smaller foramina allow the passage of other nerves and bloodvessels. Two condyles articulate with the first vertebra. There are ridges for the attachment of muscles.

The **ethmoid** lies between the orbits. The perpendicular plate forms the upper part of the septum of the nose. The horizontal plate, which is between the orbits, is pierced by numerous holes, through which branches of the olfactory nerve pass.

The **sphenoid** lies over the top of the throat, in front of the occipital and behind the facial bones; its processes form the roof of the mouth, back of the nostrils and orbits, and are in touch with all other bones of the head, and some of the bones of the face. It is bat-like in shape.

There are fourteen bones in the face:

2 **Superior Maxillary.**
2 **Malar.**
2 **Nasal.**
2 **Lachrymal.**
2 **Palate.**
2 **Turbinated.**
1 **Vomer.**
1 **Inferior Maxillary.**

The **superior maxillary** forms the upper jaw, the socket for the upper teeth, the greater portion of the hard palate, the outer wall and floor of the nose, and part of the socket of the eye. A cavity in the interior is called the 'antrum of Highmore.'

The **malar bones** form the projection of the cheek, part of the outer and lower margin of the orbit, and part of the zygomatic arch.

The **nasal bones** are situated between the orbits, and form a ridge known as the bridge of the nose.

The **lachrymal** are two very tiny delicate bones which lie just within the orbit, touching the nasal process of the upper jaw. Each is pierced by a tube which protects the lachrymal duct, through which the tears are conveyed from the eyelids to the cavity of the nose.

The **palate bones** are at the back of the nasal fossæ. They lengthen the palate, complete the nostrils, and extend to the orbits.

The **turbinated** bones are small curved bones in each nostril.

The **vomer**, or **ploughshare**, is a single bone, which separates the two nostrils.

The **inferior maxillary** forms the lower jaw. It consists of the chin, the ramus or sides, and the upright portions. At the end of each upright portion are two processes; the anterior is the coronoid process, the posterior is the condyloid, which articulates with the temporal bone, and forms a hinge joint. The space between the processes is the sigmoid notch. The alveolar processes enclose the teeth, as in the upper jaw. The lower jaw is the only movable bone in the skull. The other bones are joined together by jagged edges, which interlock, and are called sutures.

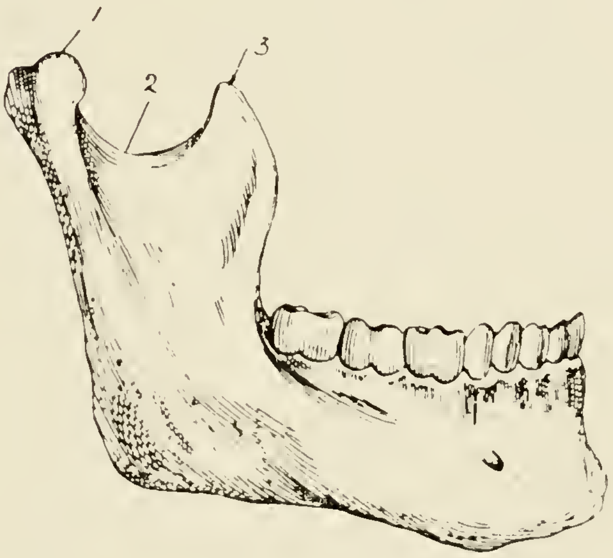

Fig. 89.—Inferior Maxillary Bone.

1, Condyle; 2, sigmoid notch; 3, coronoid process.

The **orbit** is formed by the frontal, sphenoid, ethmoid, superior maxillary, malar, lachrymal and palate bones. It contains the eye, its muscles, vessels and nerves.

The **scalp** consists of the skin of the head, with the hair-bulbs, the superficial fascia, and the occipito-frontalis muscle, with its aponeurosis. The superficial fascia binds the skin and muscle together, so that the skin of the head cannot be pinched up as in other parts.

The **nasal cavity** occupies a large proportion of the face. It is separated from the cavity of the mouth by the superior maxillary and palate bones, which form the hard palate. The roof of the mouth is continued backwards by the soft palate, which is composed entirely of fleshy substance.

The Neck.—The vertebræ of the neck are seven in number. The two upper articular processes of the first vertebra are concave, and articulate with the occipital condyles, which are at each side of the foramen magnum, and which are convex. The occipital bone around the foramen magnum is attached by special ligaments to the anterior, posterior and lateral portions of the axis. The atlas is also attached to the occiput and to the axis by strong ligaments. Some of the ligaments are inside the spinal canal. The central odontoid ligament is attached to the tip of the odontoid peg, and to the anterior margin of the foramen magnum. The lateral odontoid, or check ligaments, are attached to each side of the peg, and to the inner surface of the occipital condyles. The transverse ligament behind the peg is attached to the sides of the atlas. The head is capable of forward flexion, extension, lateral flexion and rotation. The spinous processes of the cervical vertebræ are bifurcated, except the first and the last. The transverse processes are bifurcated, and each has a hole through which the vertebral artery passes, and is thus protected by a bony wall. The ligaments of the five lower cervical vertebræ are a continuation of the anterior and posterior common ligaments of the spine. The neural arches are bound together by ligamenta subflava, interspinous and intertransverse ligaments.

The ligamentum nuchæ, which reaches from the seventh cervical vertebra to the crest of the occipital bone, is a continuation of the supraspinous ligament; it is attached by slips to all of the cervical vertebræ, its posterior border is free, and gives origin to the trapezius, rhomboid, serratus posticus superior, and splenius muscles.

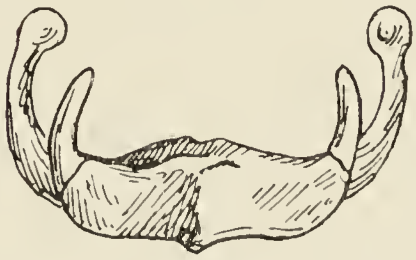
FIG. 90.—HYOID BONE.

The **hyoid** bone is shaped something like a horseshoe. It is under the lower jaw, between the root of the tongue and the larynx; it has a base, and two horn-like processes at each side; the longer horns or cornua go along the sides of the throat, the smaller are directed upwards, and are attached by ligaments to the styloid processes of the temporal bone. They keep the bones of the trachea and œsophagus extended. The chief muscles of the tongue and the trachea arise from the body of the bone; the chief muscles of the œsophagus arise from the horns. Behind the soft palate the cavities of the mouth and nose lead into the pharynx, which is continuous with the œsophagus (see Chapter VII). Air to and from the larynx, as well as food from the mouth to the œsophagus, passes through the pharynx.

The **larynx** is the organ of voice; it lies above and joins the trachea; it is in the middle of the neck, in front of the pharynx; it consists of nine cartilages, held together by ligaments, and moved by muscles. The four largest, by which the vocal cords are supported, are the thyroid, cricoid, and two arytenoid.

The **thyroid** is in the front; it is funnel-shaped, and forms the prominence called Adam's apple.

The **cricoid** forms the lower part of the cavity, and is in shape like a signet-ring.

The two **arytenoids** are on each side at the back, on the upper border of the cricoid.

The **epiglottis** is a heart-shaped fibro-cartilage behind the root of the tongue, and in front of the superior opening of the larynx. In the act of swallowing, this opening is closed by the folding forward of the two arytenoid cartilages, so that their apices are applied to the epiglottis, and thus solid or liquid matter is prevented from going into the trachea.

For vessels and nerves, see Chapters III. and IV.

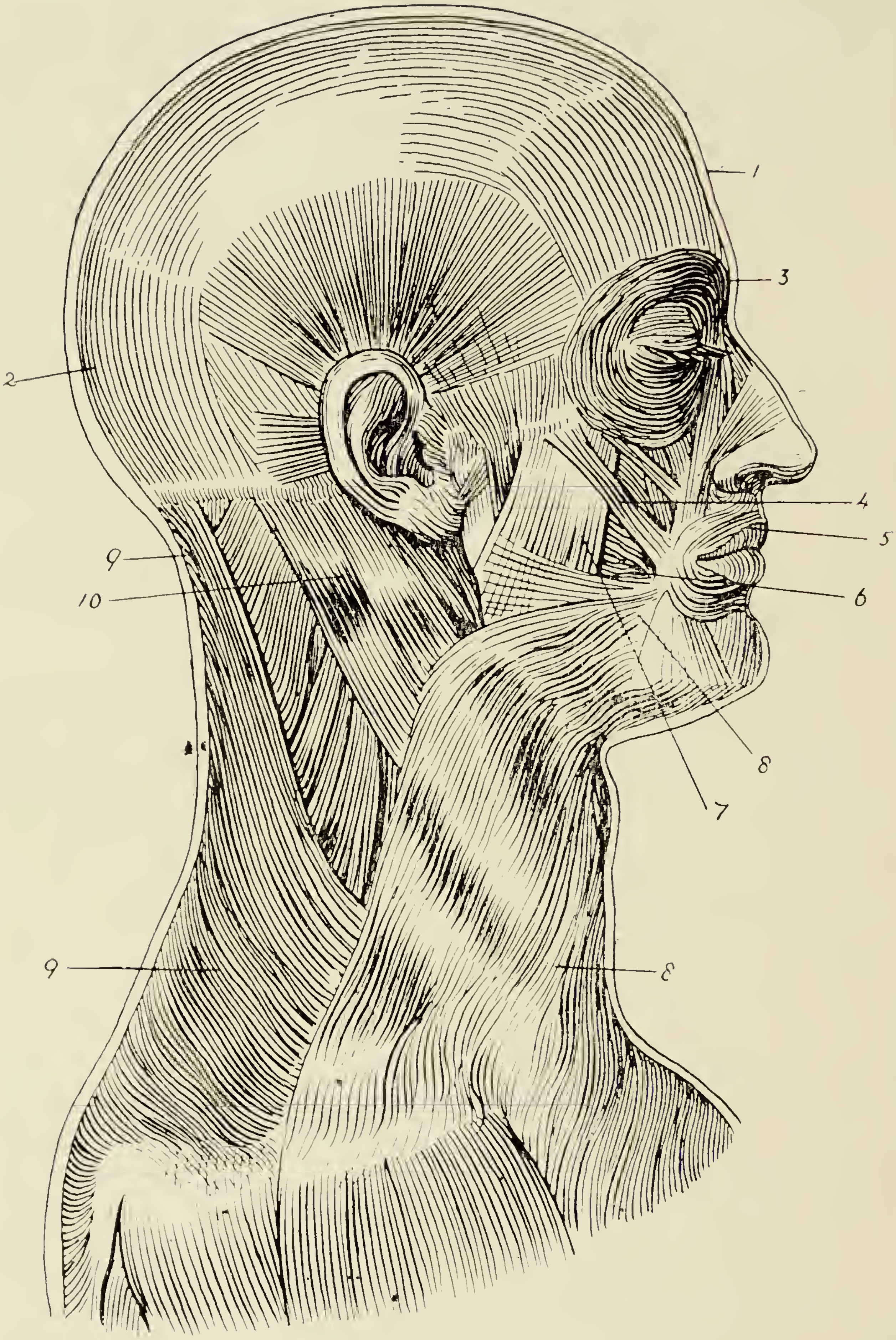

Fig. 91.—Muscles of the Head.

1, Frontalis; 2, occipitalis; 3, orbicularis palpebrarum; 4, zygomaticus major; 5, orbicularis oris; 6, buccinator; 7, masseter; 8, platysma myoides; 9, trapezius; 10, sterno-mastoid.

SOME MUSCLES OF THE HEAD, FACE AND NECK.

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Occipito-frontalis.	Superior curved line of occiput, mastoid portion of temporal bone.	Eyebrow, root of nose.	Moves scalp.	Branches of: Trigeminal, facial, great auricular, great and small occipital.
Temporal.	Temporal fossa and fascia.	Coronoid process of lower jaw.	Raises lower jaw, presses it against upper.	Inferior maxillary.
Masseter.	Upper part of superior maxillary bone.	Lower part of inferior maxillary bone.	Raises lower jaw, presses it against upper.	Inferior maxillary.
Pterygoid (external).	Zygomatic fossa, two heads.	Neck of condyle of lower jaw.	Draws lower jaw backwards and sideways.	Inferior maxillary.
Pterygoid (internal).	Zygomatic fossa, two heads.	Angle and ramus of lower jaw.	Draws lower jaw backwards and sideways.	Inferior maxillary.

The last four are muscles of mastication, two outside and two inside the jawbones.

SOME MUSCLES OF THE HEAD, FACE AND NECK—*continued.*

Name.	Origin.	Insertion.	Action.	Nerve Supply.
Buccinator.	Alveolar borders of superior and inferior maxillary.	Orbicularis oris at angle of mouth.	Keeps food between grinders. Used also in blowing and whistling.	Facial.
Zygomaticus.	Malar bone.	Orbicularis at angle of mouth.	Draws corners of mouth upwards and backwards.	Facial.
Orbicularis palpebrarum.	Internal margin of orbit.	External margin of orbit, surrounds eye.	Closes eye.	Facial.
Orbicularis oris.	Surrounds mouth, is formed by fibres of several muscles.	To its fellow at angles of mouth.	Lips pressed together and pushed outwards.	Facial.
Risorius.	Fascia over masseter.	Angle of mouth.	Draws corners of mouth back.	Facial.

Platysma myoides.	Fascia over superior part of deltoid and pectoral muscles, clavicle and acromion.	Lower jaw and angle of mouth.	Draws down corners of mouth, assists in swallowing.	Superficial cervical.
Sterno-cleido-mastoid.	Two heads from sternum and clavicle.	Mastoid process.	Bend head forward and to one side.	Spinal accessory.
Digastric.	Two bellies: (1) Mastoid process. (2) Lower jaw.	Hyoid bone.	Depresses jaw or raises hyoid bone.	Facial.
Omo-hyoid.	Upper border scapula.	Hyoid bone.	Depresses and retracts hyoid bone.	Branch of hypoglossal.
Sterno-hyoid.	Inner end of clavicle and sternum.	Hyoid bone.	Depresses and retracts hyoid bone.	Branch of hypoglossal.
Scaleni, three.	Transverse processes cervical vertebræ.	Upper border two first ribs.	Flex head forwards and sideways.	Cervical.

MASSAGE OF THE HEAD.

The operator stands in front, but rather to one side of the patient, who is seated.

The head is steadied with one hand, the fingers of the other hand are drawn together, and firm friction is made over every part of the scalp. The pressure must be sufficient to move the scalp thoroughly on the skull; this is sometimes difficult, owing to the tight and matted condition of the scalp; sometimes the scalp on one side of the head is freely movable, and on the other almost fixed. Friction may also be done with the whole palmar surface of both hands working together.

Much relief is felt from these movements when the head is tired and heavy. They are said also to promote the growth of the hair.

A very soothing movement, useful in nervous headaches and to promote sleep, is done with the cushions of all the fingers of both hands, working slowly in circles from occiput to forehead, without pressure; the wrists are raised. Circular movements on the crown of the head are most soothing, as also are circular movements round the mastoid process.

If used to induce sleep, the patient would probably be in bed; in this case the movement should begin at the crown.

THE FACE.

Supra-orbital Neuralgia.

1. The thumb is placed on the supra-orbital notch on the affected side, and the supra-orbital nerve is pressed against the bone; this frequently arrests the pain. The course of the nerve upwards may be followed with friction with the thumb.

2. Friction with thumb from middle of forehead to temple, effleurage from temple to middle line, following the course of veins. The tissue should be all well moved about and then stretched.

When the pain is below the orbit, friction is done from the angle of jaw to middle of the mouth, pressing on the maxillary bones.

All the muscles of the cheek kneaded with thumb and fingers, to be followed by circular effleurage with palm of hand.

The Eye.

1. The cushion of the thumb is placed on the closed lid, pointing to the nose; by friction the lid is made to work over the eyeball.
2. Stroking with thumb from outer edge of orbit to nose on upper and lower lid.
3. The lid picked up between finger and thumb, and moved up and down.
4. Friction on supra and infra orbital, and supra and infra trochlear nerves, relieves pain in the eye.
5. Gentle pressure from outer angle of eye, inwards to and down side of nose, relieves congestion and swelling.

Facial Paralysis.

1. The muscles of the affected side of the face are kneaded with thumb and finger.
2. Friction of forehead and side of head and corner of mouth.
3. Circular movements round mouth and eye.
4. Vibrations with tips of fingers.

Stiff Jaw.

1. Friction about the joint.
2. Pétrissage of all muscles that move the joint. Improvement may be tested from time to time by insertion of bits of wood between the teeth. A screw gag is sometimes used.

Wry Neck.

The patient is seated, and is uncovered to below the scapula. The operator sits behind on a higher seat than the patient. In severe cases the muscles of the chest and back, as well as those of the neck, are pulled awry, and there is cervical curvature, and even upper dorsal curvature. The head is held with one hand, while the work is done with the other; the back should be fixed against the chair.

1. Every part of the neck is stroked, also upper part of spine.

2. Sterno-mastoid and all muscles of the neck are kneaded with thumb and finger and with heel of hand, also pectorals and shoulder muscles.

Passive movements: Forward flexion of head, extension, rotation.

Manipulations of the throat are useful in weakness of voice.

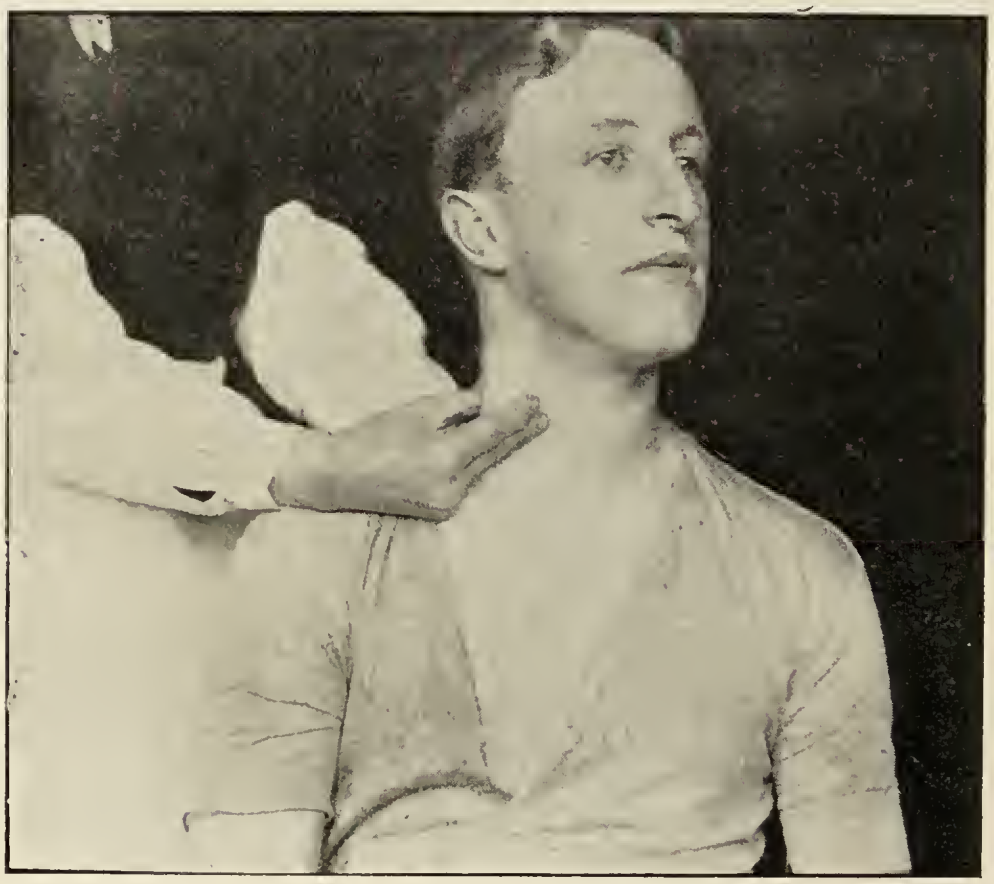

FIG. 92.—KNEADING THE STERNO-MASTOID.

1. The thumb is placed well up under the jaw at one side of the larynx, and the index-finger opposite to it on the other side; a backward and forward movement is made in which the skin is moved with the fingers, the movement being made on the cartilages. This is continued down trachea.

2. Friction at each side of trachea.

3. Work all muscles that can be got at in front of throat between thumb and finger.

4. Effleurage.

Active movements: The patient opens the mouth to full extent, closes, many times. The lower jaw is carried out sideways many times.

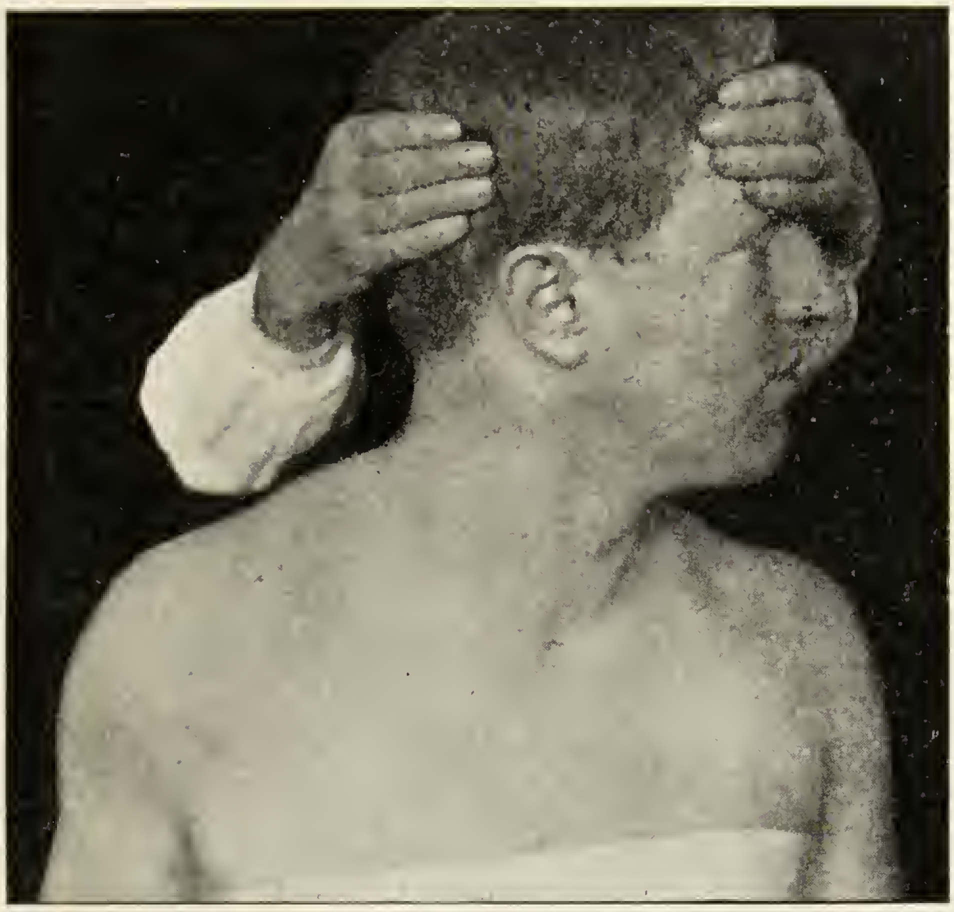

Fig. 93.—Rotation of the Head.

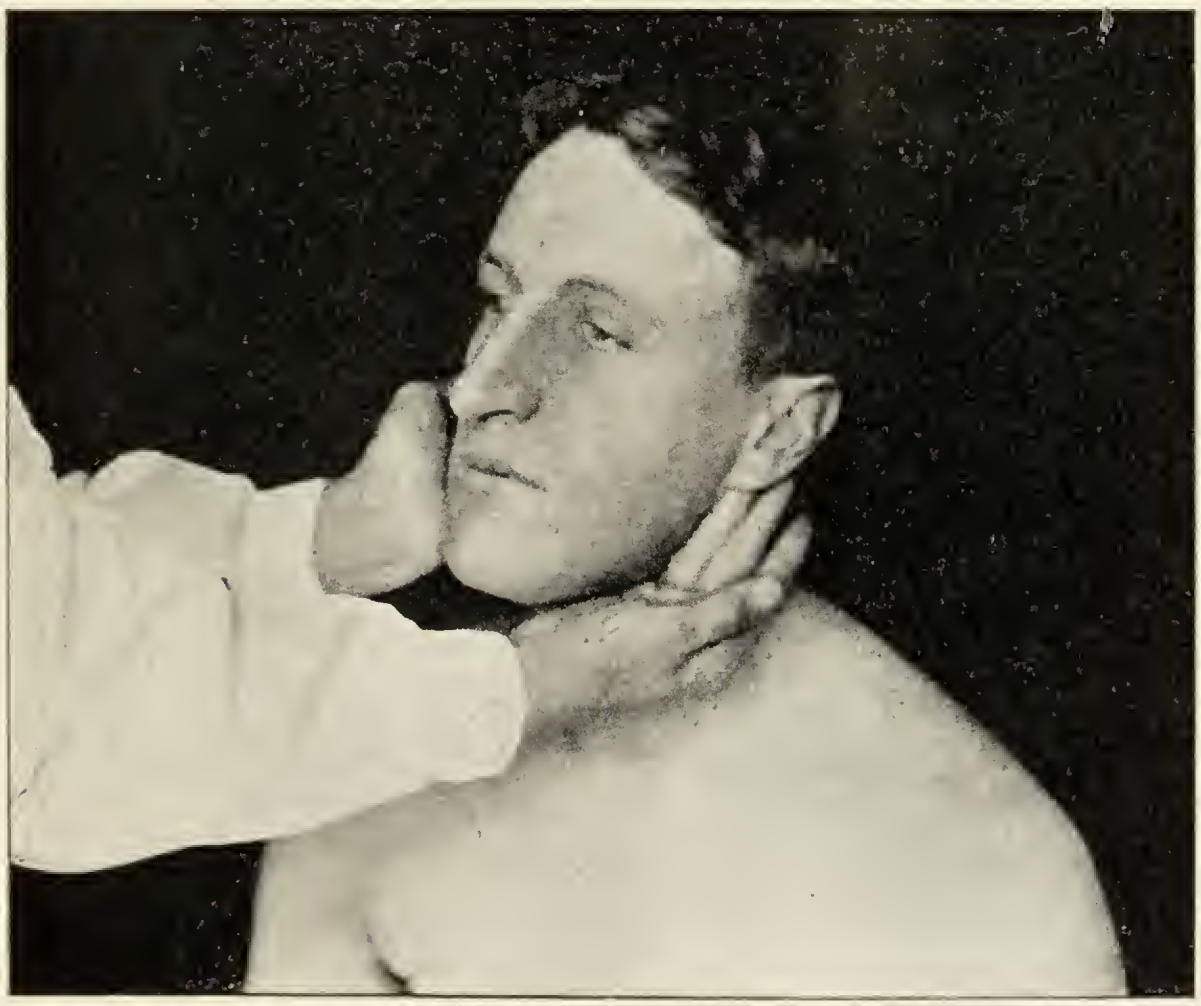

Fig. 94.—Throat Effleurage (Gerst's Method). Beginning of the Movement.

Congestion of the head, and catarrh of the nose, pharynx, and larynx, are relieved by throat effleurage. It is done in three ways.

Gerst's Method.—The patient sits or stands with her head tilted back; the operator stands in front. The ulnar borders of the hands with palms upwards are placed well under the lower jaw, the little finger being in the groove under the ear, and the end of the third and second finger on the mastoid processes. The hands simply rotate on their own axis till the radial borders reach the clavicle, and the palms are turned downwards; close contact and moderate pressure must be maintained all the time with the whole of the palms.

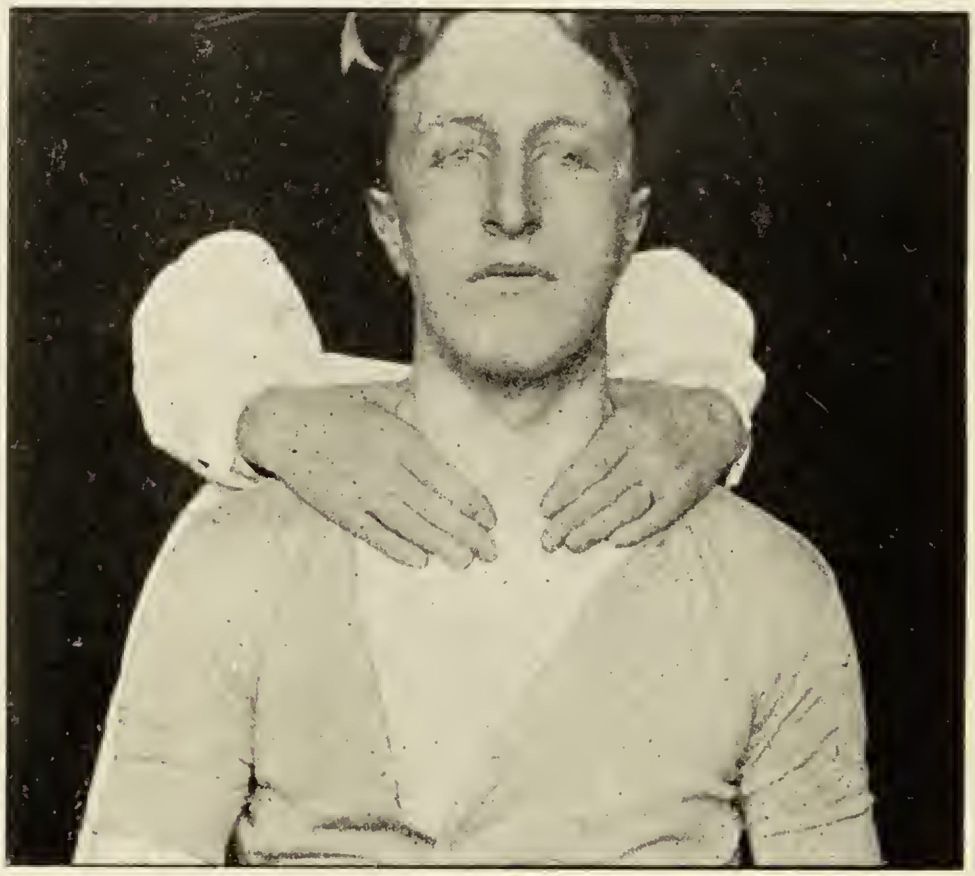

FIG. 95.—THROAT EFFLEURAGE (HOFFINGER'S METHOD). END OF THE MOVEMENT.

Pressure is made on the jugular and other veins, and on the lymphatics of the neck. This movement requires much practice and flexible wrists.

Hoffinger's Method.—The patient is seated, and the operator stands behind. The thumbs are at the back; the little fingers are close under the jaw; the palms are kept in close contact with the neck as the hands come down with moderate pressure till the index-finger lies along the clavicle. In this movement the elbows are turned out as the hands rotate. In Gerst's method the elbows are kept close to the sides.

Weiss's Method.—The operator faces the patient, and places the hands round the neck, fingers at the back and thumbs in front. The stroking is done with the thumbs over the jugular veins.

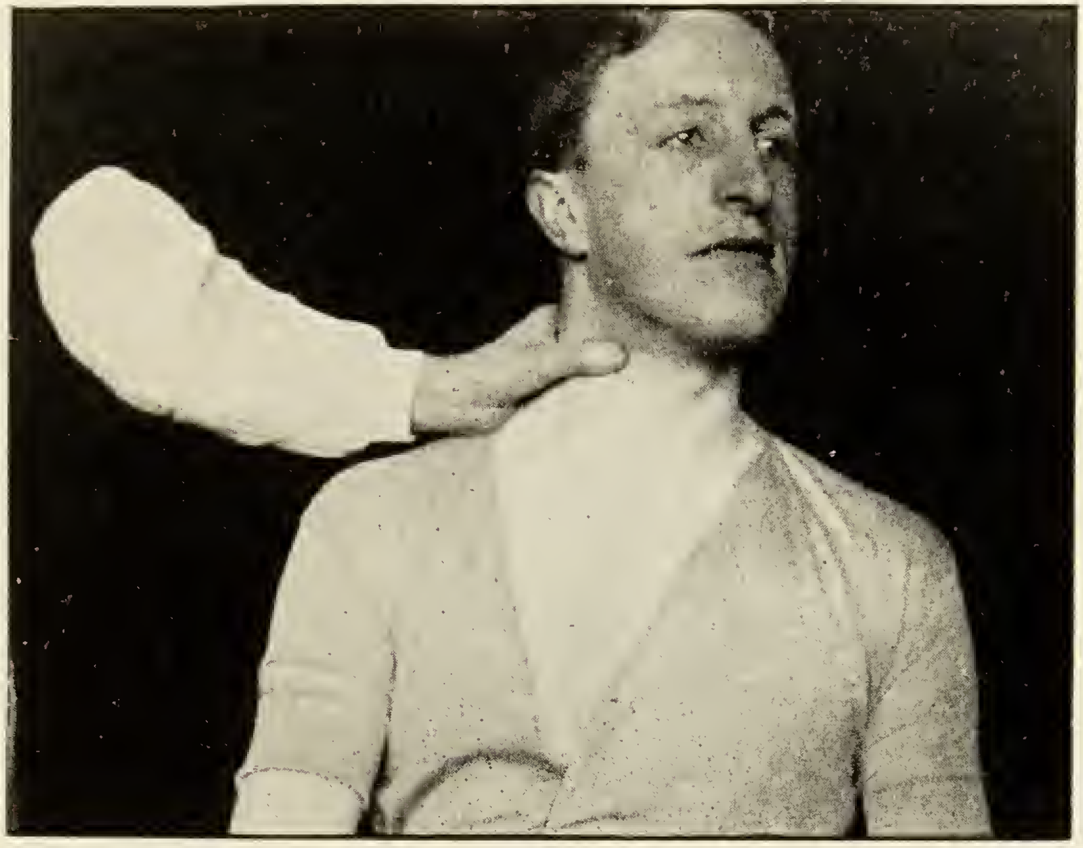

FIG. 96.—THROAT EFFLEURAGE (WEISS'S METHOD).

In each method the patient should breathe deeply, to assist venous circulation.

CHAPTER X.

MASSAGE OF SPECIAL REGIONS

It is important that the mechanism of all principal joints should be studied, as they give a great deal of work to the masseuse, and her success in the treatment of sprains, etc., greatly depends on her knowledge of the structure and functions of the parts involved. She should also understand how to bandage.

Recent Sprain.—In a sprain, ligaments are overstretched, and may be torn; the sheaths of tendons may be torn; blood-vessels are wounded, and blood is poured out into the spaces of the tissues and into the synovial sacs; the result is swelling and pain.

The Ankle.—The operator sits beside the bed or couch facing the patient, with the hands on a level with the limb. If possible, the foot is raised on a pillow to favour return circulation, but it is not well to move about a painful limb.

If the foot has been twisted inwards at the time of the accident, the outer side will be the most discoloured and painful, and abduction will be impossible, owing to the pain caused. If the foot has been twisted outwards, the inner side will be the worse and abduction the most painful movement. Only flexion and extension should be used for some days. If a bandage has been applied, it must be removed most carefully.

1. First visit: Effleurage for five minutes with one flat hand from ankle to above knee; leg supported by the other hand.

2. Effleurage lightly, with tips of fingers encroaching on injured part, avoiding the most painful spots; the whole foot to be carefully gone over to find out the most tender parts.

3. Repeat No. 1 for two minutes.
4. Flexion; extension (ten minutes in all).

Second visit: The bruises will be found of a deeper colour and spread over a larger surface, perhaps even reaching to the popliteal space. This need cause no alarm; the manipulations given the previous day have brought the extravasated blood to the surface and spread it onward, a result much to be desired. The swelling and heat will be less. Treatment as before.

As improvement takes place, the manipulations may be more vigorous and rapid. As the fluid is absorbed, the shape of the foot becomes natural, tenderness decreases, the tissues are freely handled, and the treatment proceeds as in Chapter VI. Passive movements are given from the first to prevent adhesions from forming, and the joint becoming stiff. Effleurage of the leg is given to relieve the tension at the ankle by accelerating the circulation and encouraging absorption by the lymphatics. In this way the injured and painful tissues are relieved, and prepared for more direct manipulation. The bandage to be readjusted after each *séance*. If, instead of a bandage, a cooling lotion is at first being applied, the cloth is freshly wrung out and laid on.

All sprained joints are treated after the same fashion. In the case of the wrist, the fingers require manipulation, also the elbow, and passive movements to all the joints.

SYNOVITIS OF THE KNEE.

There is a great deal of swelling, because of the large synovial membrane and the bursæ in its neighbourhood.

Effleurage of thigh for five minutes, to be followed by movements for knee (described in Chapter VI.), applied superficially. In acute cases the tenderness is great, and the passive movements (extension and flexion) give much pain, and should be very gently done. Many accidents happen to the knee, but the treatment is the same. In each case the object is to reduce swelling, to strengthen the joint, to improve the muscles, and to restore movement. Absorption of fluid is helped by squeezing; the limb is grasped above and below the patella and intermittent pressure given with both hands; the hands are then pressed towards each other. After the swelling is reduced and the knee fairly well, there is still thickening of tissue, which is got under by friction.

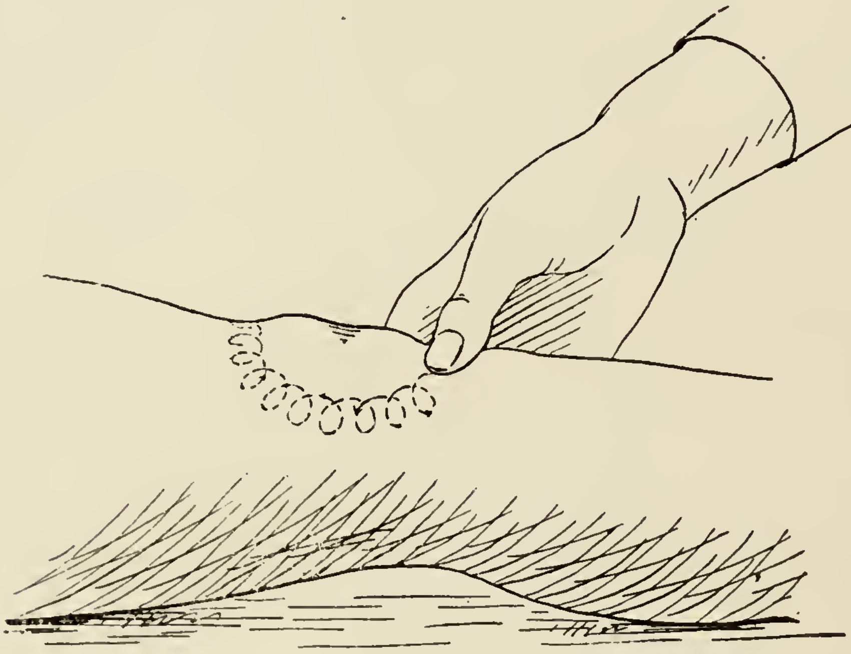

FIG. 97.—FRICTION ROUND THR KNEE.

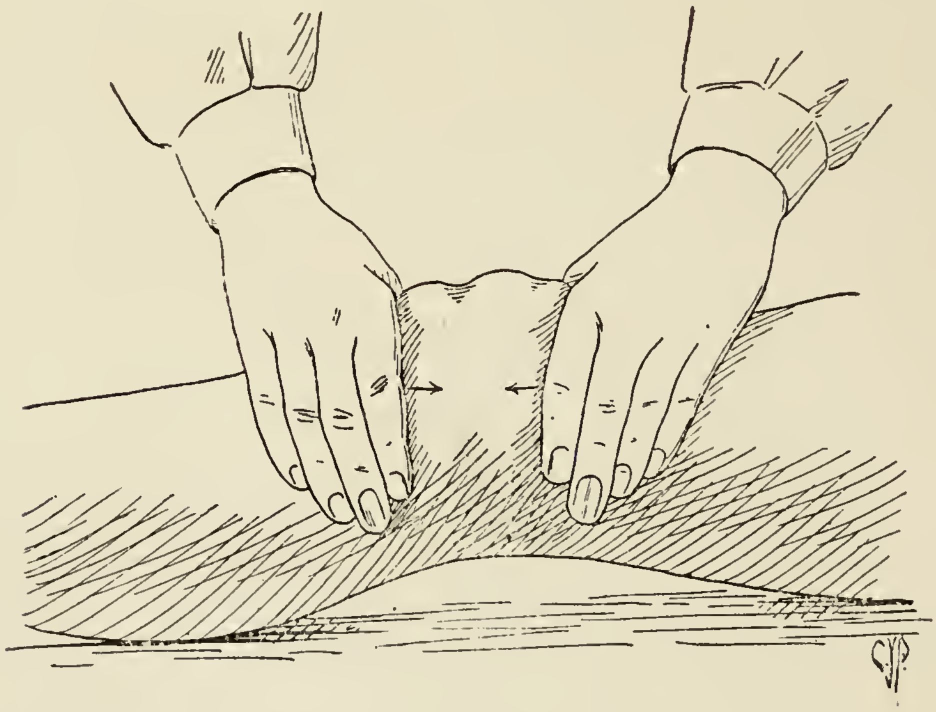

FIG. 98.—SQUEEZING THE KNEE TO REDUCE SWELLING.

Massage should not be applied directly to a joint while there is inflammation, but above it. It may be hours or days before the joint itself may be manipulated. Increased heat or swelling after massage of a joint would indicate that the treatment should be suspended.

However painful flexion and extension of a joint may be at the moment, it should almost immediately subside. If the pain continue for hours, advice should be sought, as formation of pus or diseased bone might be present. In chronic cases the joints can be freely handled. In knee troubles the extensor muscles of the thigh waste quickly, and should be thoroughly well masséed. All the thigh muscles should have attention, as it is as important to improve their condition as to restore the movement of the knee.

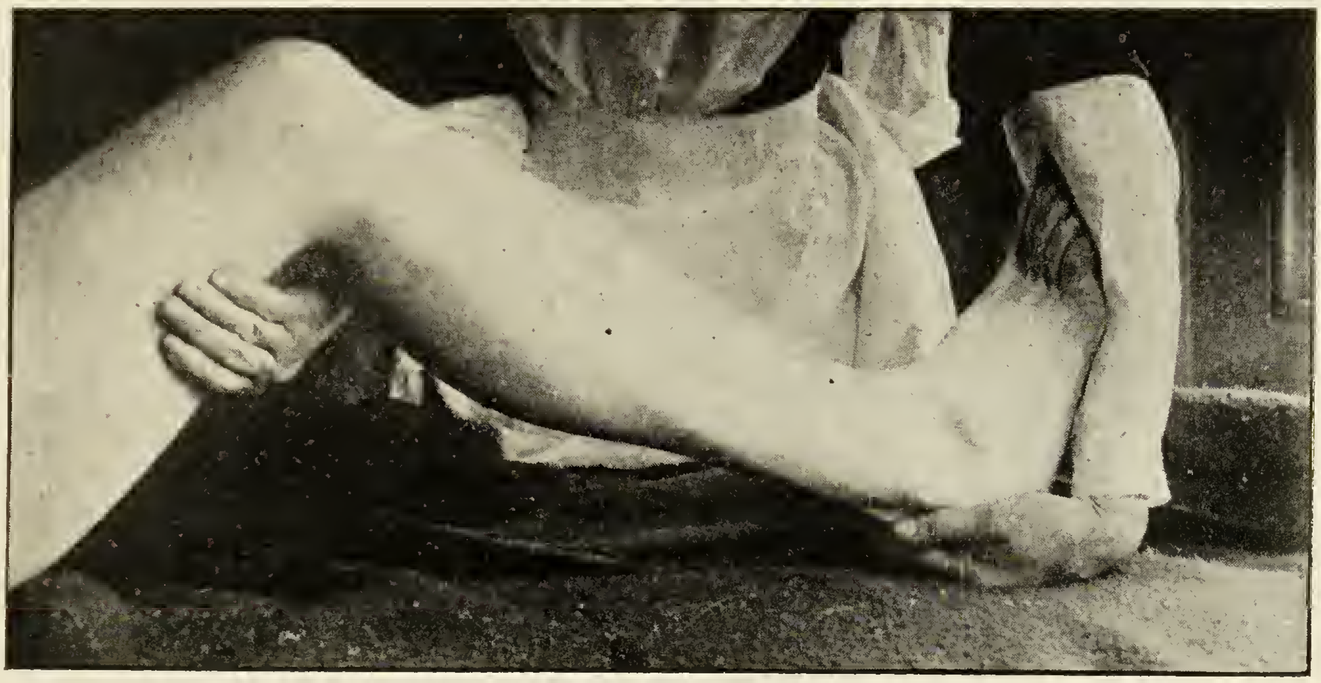

FIG. 99.—FLEXING THE LEG.

The remarks as to bandages, etc., apply to all joints.

Joints are well supplied with bloodvessels and lymphatics. When a joint is congested and inflamed, the object in giving massage above it is to relieve the over-charged vessels. Manipulation of the joint would cause pain and increase local circulation, two things to be avoided.

In chronic joint troubles, such as old sprains or stiffness from any injury, the local circulation and secretion are decreased, therefore the joint is manipulated in order to bring blood to it and favour secretion.

The treatment of these joints is different to the foregoing;

they are not painful to the touch, therefore massage movements are applied vigorously from the first.

Hot and cold applications are sometimes used in connection with massage. Soaking the part in hot water or hot fomentations are useful before kneading and passive movements. The muscles above and below the joint require attention, as they have suffered from inaction, and must be nourished and strengthened to act on the joint.

The movement of the joint is painful, and fortitude is called for in both operator and patient—in the one to enable her to cause exquisite misery, in the other to bear it.

A joint should not be flexed or extended till massage has been applied (see Chapter V.).

When up and about, various devices are used to fix the body of the patient. If a stiff shoulder, the patient may sit sideways on a chair with the healthy arm over the back, thus fixing the trunk and placing the other shoulder in a good position for grasping the scapula.

To move a stiff elbow, the patient sits with the back against the wall.

To flex a stiff knee, the patient sits on a high seat which admits of the leg going back, the thigh is fixed by one hand placed above the knee and the leg pressed backward with the other hand, or when the knee is somewhat bent, an easy way to gain movement is for the operator to place her foot on the foot of the patient and exert pressure in that way. The patient may be instructed to do active movements after this wise: Standing behind a chair with hands grasping the back, both knees are bent as far as the stiff one can be made to go; this should be done many times. A stiff ankle can also be exercised in this way.

Should adhesions have been recently broken down under anæsthetic, gentle movements should be used at first, as in sprains, as the conditions are somewhat similar. Injury to a joint is sometimes followed by neuritis and rapid wasting of the adjacent muscles. The first object then is to restore tone to the muscles.

In stiff hip-joints the glutei muscles are wasted, and require vigorous kneading and tapotement, the joint to be manipulated as in Chapter VI. The adductors to be well kneaded, etc., also finger-kneading across the top of the thigh. All the rotators of the hip-joint are inserted into or near the trochanters. Abduction is generally the most difficult movement to get. It is necessary to have the pelvis held by another in order to fix it.

After dislocation of the shoulder or fractured humerus, the deltoid, supra and infra spinatus, and the pectorals are found to be wasted, and require as much care as the joint itself. In some cases the movement of the joint is perfect, but the patient cannot raise the arm because of the weakness of the wasted muscles. Nutrition must be brought to them before passive movements are used, as it is worse than useless to force muscles to do what they have not strength for. The folds of the axilla require attention (see Chapter V.).

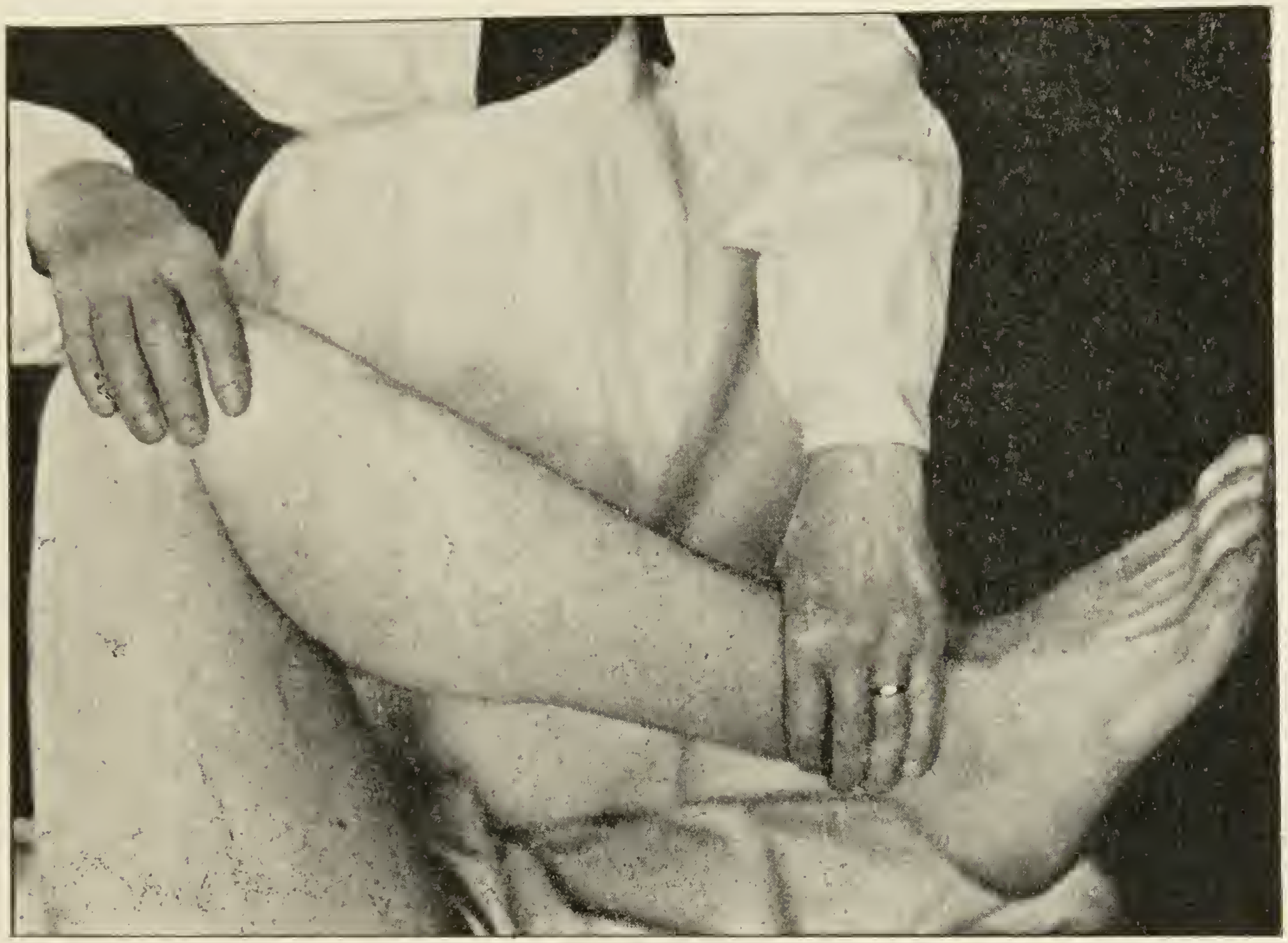

FIG. 100.—FLEXING THE THIGH.

If there has been downward dislocation of the shoulder, care must be exercised in abducting the arm when giving passive movements.

Lawn-Tennis Arm.—1. Effleurage triceps.

2. Light circular movements over back of forearm, avoiding tender spots.

3. Passive movements.

There is sometimes a soft swelling on the outside of the forearm, just below the elbow-joint, about the size and shape of an egg, which should be carefully treated with light circular movements. Movements of flexion, extension, pronation and supination should be made very carefully. Pronation is most painful.

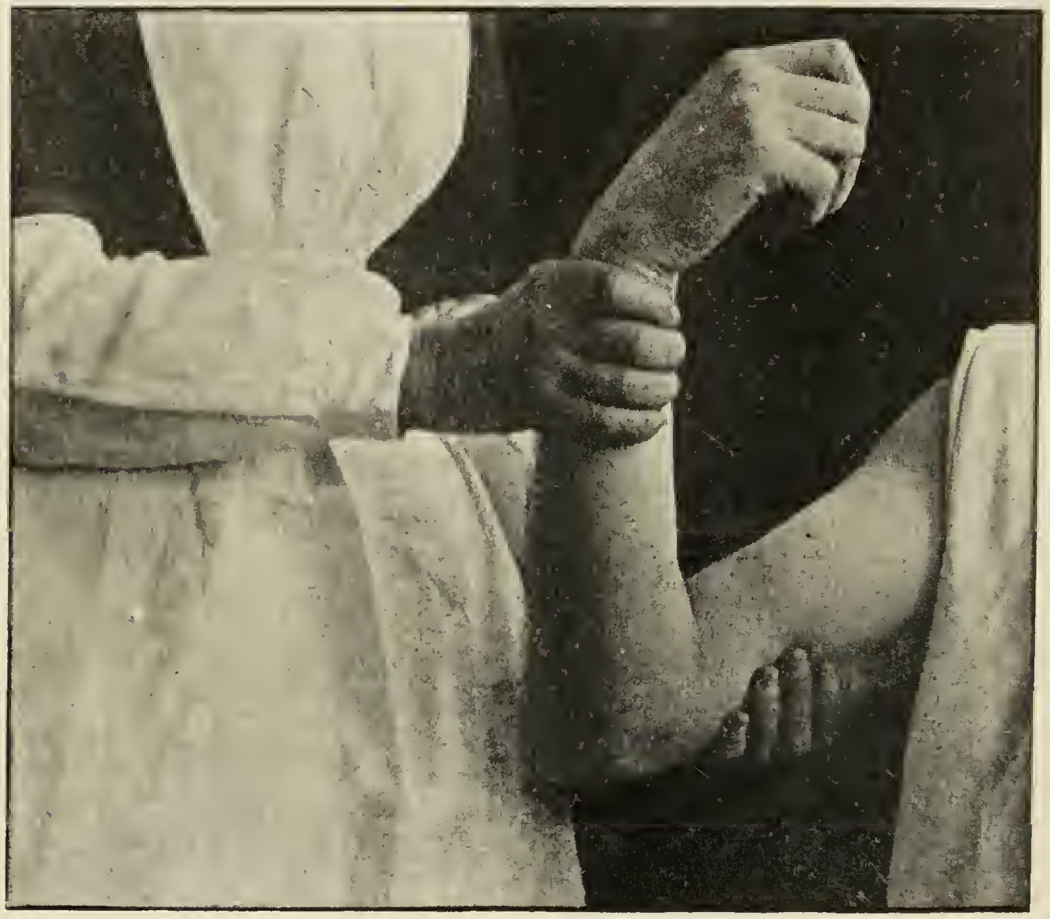

FIG. 101.—FLEXING THE FOREARM.

One of the first experiments made by Professor von Mosengeil was on the joints of a rabbit. He injected Indian ink into the knee-joints of a rabbit; one joint was masséed, but not the other. This was repeated three times, at intervals of two hours, the rabbit being set free between. At the last attempt to inject, the knee that had not had massage would not receive the ink, and was much swollen. The rabbit was killed, and the swollen knee was found full of ink, while in the knee which had massage no ink was found, and there was no swelling; ink was found in the lymphatics leading from the joint and in the glands beyond. The muscles on the side that had been masséed were black. This experiment proved the value of massage in effusion in joints.

Recent Fracture.—If the limb is in splints, they must be removed with care to avoid displacing the fragments; the same precaution applies to sand-bags and bandages, if they are used.

When only one of the leg bones is fractured, the leg is sometimes supported only by sand-bags. If the tibia and fibula are both fractured, a back splint with foot-piece and side splints are used; the side splints should not be allowed to drop off suddenly when bandages or straps are unfastened. The back splint had better not be removed for the first few days, and when it may be removed it is sufficient to draw it down only far enough to admit of giving passive movements to the ankle-joint; the fracture is supported with one hand while the splint is being moved. Later on, when it is taken quite away and there is fairly firm union, the knee-joint is moved, the thigh is raised with one hand while the leg is pushed back with the other hand, which at the same time steadies the fracture. The above remarks apply to fresh fractures—that is, from a few hours after the injury till union has taken place. The points for the masseuse to remember are, first, that she should not do too much; effleurage is the only movement necessary for some time, done as gently, evenly, and lightly as possible, pressure being very gradually increased. Until experience teaches, it is difficult for a masseuse to believe that such slight movements can be of so much use. After some days kneading, in whatever form it can best be accomplished, is added, also squeezing. Fulling and tapotement are not permissible.

The next point is care in readjusting the splints; the heel and sole of foot must fit closely to the foot-piece of the back splint; the side splints must also fit accurately. Massage is never anything but comforting and pleasant to patients with fractures, but needless pain may be caused by pressure of badly-adjusted splints or too tight bandages or straps.

The limb must be steadied with one hand while the work is done with the other. In passing over the fracture, raise the fingers at the distal side, and replace them at the proximal side, without interrupting the stroke, making a bridge, as it were, thus passing the fracture without touching it, and without a jerk; perfectly even work is of the greatest importance.

Massage is given immediately after a fracture to assist the absorption of blood which has been poured out by vessels in the neighbourhood having been ruptured, to prevent matting of soft parts, to prevent the formation of adhesions, to allay pain, to lessen muscular spasm, and to prevent muscle-wasting.

The toes in the case of a leg, and the fingers in the case of an arm, may be gently flexed and extended from the first.

In a **fractured patella** care must be taken not to draw the fragments apart, or to stretch the connecting fibres while striving by manipulations to prevent adhesion of the patella to the femur.

The fragments should be held in position by one thumb and index-finger being placed on the upper and lower borders, while the work round the patella is done with the other thumb and fingers.

In **Pott's fracture** the work is commenced, as in a bad sprain, by effleurage above the ankle, the injured part being gradually encroached on. Gentle flexion and extension of toes and ankle from the first.

Writers' cramp, or, properly speaking, occupation neurosis, is a complaint to which writers, telegraphists, knitters, painters, pianists, violinists, watchmakers, and others who continually use the muscles of the forearm and small muscles of the hand in one way are liable. Cases differ very much. There may or may not be pain, there may be spasm of the flexors or of the extensors, trembling, rigidity, or paralysis. In some cases, when writing, the thumb gives way, and the hand suddenly pronates without pain or spasm.

The whole limb must be masséed from fingers to shoulder, also the upper part of the spine:

1. Vibratory movements to tip of each finger.
2. All fingers movements, including joints.
3. Thenar and hypothenar eminences, interossei and lumbricales well kneaded.

4. All ordinary movements given to upper limb (see Chapter V.). The muscles most affected to be sought out and given special care.

Exercises.—As it is a fatigue disease, passive movement only should be used at first. Flexion and over-extension of each finger-joint. Abduction of fingers, drawing each as far as possible from its neighbour. Abduction, elevation and backward movement of extended arm. Circumduction. Flexion and over-extension of wrist.

All the exercises are large and wide; the arm is carried well away from the body; they are the reverse of the positions assumed in writing, or whatever occupation has caused the trouble. Later on resistance may be given. To resist abduction of the fingers, the operator's thumb and second finger is placed on the side of the patient's thumb and little finger. Or an elastic band may be placed over the fingers against the resistance of which the patient abducts the fingers. The strength of the band to be increased as the fingers become stronger.

SCIATICA.

The position of the patient and operator depends on the condition of the former. The patient may from pain be quite unable to move, and, if lying on the back, the work must be done in that position. The knee will probably be flexed, in order to relax the painful and inflamed nerve; or the patient may be more comfortable lying on one side. It must be the side which is not affected. In the prone position the nerve is more easily got at in all its course, but the leg must not be strongly extended. If there is a tendency to this, and to contract the muscles, a pillow under the ankle will sufficiently relax them.

The Foot.—Effleurage. Kneading of sole with palms of hands and with thumbs; effleurage of dorsum; compression between hands; pressure upward with thumbs between heel and inner ankle.

The Leg.—Effleurage on back and outer side. Pétrissage with palms, thumbs meeting on the middle of the calf; work to be continued up beyond popliteal space. Effleurage; pétrissage repeated. Slapping specially over nerves. Rolling effleurage.

The Thigh.—All movements begin below popliteal space. Effleurage; pétrissage with palms, thumbs meeting on top and good pressure made on internal popliteal and sciatic nerve, effleurage; friction with thumb on nerves, effleurage; friction with ulnar border of closed hand over nerves, hacking, beating, rolling effleurage.

The Buttock.—Deep pétrissage of every description, hacking and beating.

The whole limb vigorously stroked.

The patient turned on back; the nerve is stretched. (*a*) Thigh strongly flexed on abdomen obliquely; (*b*) leg extended, heel drawn down and foot bent backward; (*c*) leg abducted.

This supposes a limb in good condition and a nerve fairly tolerant of pressure. The pressure produces numbness, and this relieves pain. If the limb should be emaciated, more attention should be paid to the working up of the whole of the muscles. As well as the effleurage which follows the special treatment of the nerve, all other movements must be added.

The nerve in other cases is so inflamed, it is wisdom to avoid it, kneading and stroking at each side of it, and for friction substituting circular effleurage over it; done very lightly and very slowly, it is most successful in allaying pain.

Sometimes there is much tenderness of skin, especially over the buttock and upper part of the thigh, when deep movements are borne better than light ones. The muscles may also be very painful. The movements must be modified to suit each individual case.

Sciatica readily yields to massage treatment, except when it is caused by growth, etc.

Neuralgia of the anterior crural nerve is sometimes associated with sciatica.

FLAT FOOT.

Massage and exercises are very useful in commencing flat foot, and certainly arrest it.

The sole of the foot and calf of the leg require special attention, but the peronei and tibialis anticus muscles must by no means be neglected. All the movements for the foot and toes (Chapter VI.) are used, to which are added:

1. Deep kneading with the thumbs on the sole, and a quick, flapping movement done crosswise with the heel of the hand and ends of the fingers alternately. Slapping.

2. The ankle to be well kneaded and moved in every direction. The tarsal bones require special attention.

3. The knee is bent so that the foot rests on the couch; the operator sits facing the patient. Leg is vigorously stroked. Each group of muscles is kneaded in turn with fingers and thumbs and with palms. Care must be taken to get at the deep muscles of the calf, the tibialis posticus, flexor longus digitorum and flexor longus pollicis. This will be better accomplished by working with the fingers and making the thumbs the fixed points in deep kneading with the whole hand. The peronei and tibialis anticus are kneaded in the usual way. Fulling, squeezing, slapping, and rolling effleurage.

Exercises.—The chief are the tip-toe exercises:

1. Patient standing erect with hands on hips to rise to tiptoe, the toes being turned in; then slowly to bring heels to the ground. Repeat, but not to cause fatigue. The number of times to be increased according to strength.

These exercises strengthen the long and short flexors of the toes, the tibialis posticus, and tibialis anticus.

2. Standing on outer border of feet. This throws up the arch, stretches the peronei and relaxes the adductors of foot.

3. Standing on heels and toes alternately; this exercises the tibialis anticus.

4. Sitting on couch, legs crossed tailor fashion, the outer border of feet resting on couch; this throws up the arch, and is a most restful position for the feet.

Bathing the feet in warm water, followed by douches of cold water before massage, is helpful. Flat feet usually perspire freely, and require to be frequently dried while being masséed.

The patient should rest after treatment, which, when possible, should be given two or three times a day.

If the muscles of the leg are very weak, and there is much pain in the foot, tip-toe and other active movements should not be used at first till the muscles are strengthened by massage. In severe cases absolute rest for a while is enjoined, and the thigh is manipulated as well as the leg. Exercises should always stop short of fatigue, and be increased gradually.

PHLEGMASIA DOLENS.

Massage is given for the œdema and woodiness that are left after this disease. Great care is necessary to give the movements evenly and steadily, as a jerk might bring about fatal consequences, by detaching a clot and sending it into the general circulation. Pincement is a suitable movement.

VARICOSE VEINS.

Pressure is to be avoided on the varicose veins, and circulation improved in the collateral veins by massage of the rest of the leg.

CHAPTER XI

SPINAL CURVATURE

THE curvatures with which the masseuse has to deal are:

Posterior (Kyphosis).
Anterior (Lordosis).
Lateral (Scoliosis).

Angular curvature, being a disease of the bones, does not come within her province.

In **posterior** curvature the back is bowed backwards, in the dorsal, cervico-dorsal or lumbo-dorsal region; the head bends downward and forward, the shoulders fall forward, the chest is flattened and narrowed, the muscles of the abdomen are contracted and shortened as the long muscles of the back are stretched and lengthened. It may be the result of short sight, or, in the case of an adult, of occupation, such as fatigue from bending forward over some work for hours. In any case there is weakness of the muscles of the back.

The patient lies prone, with arms by sides. The ordinary movements for the back are first done; in this way the trapezeus, latissimus dorsi, rhomboids, are worked up; then to get at the deeper muscles, the long extensors of the back, the erector spinæ and its continuations:

1. Friction with thumb on each side from occiput to sacrum between the spinous and transverse processes in the vertebral groove. The circles should be carefully and firmly made with the thumb, and the muscles felt to work on each other under it.

2. The first and second fingers are separated and drawn down rapidly and with fair pressure over the same region.

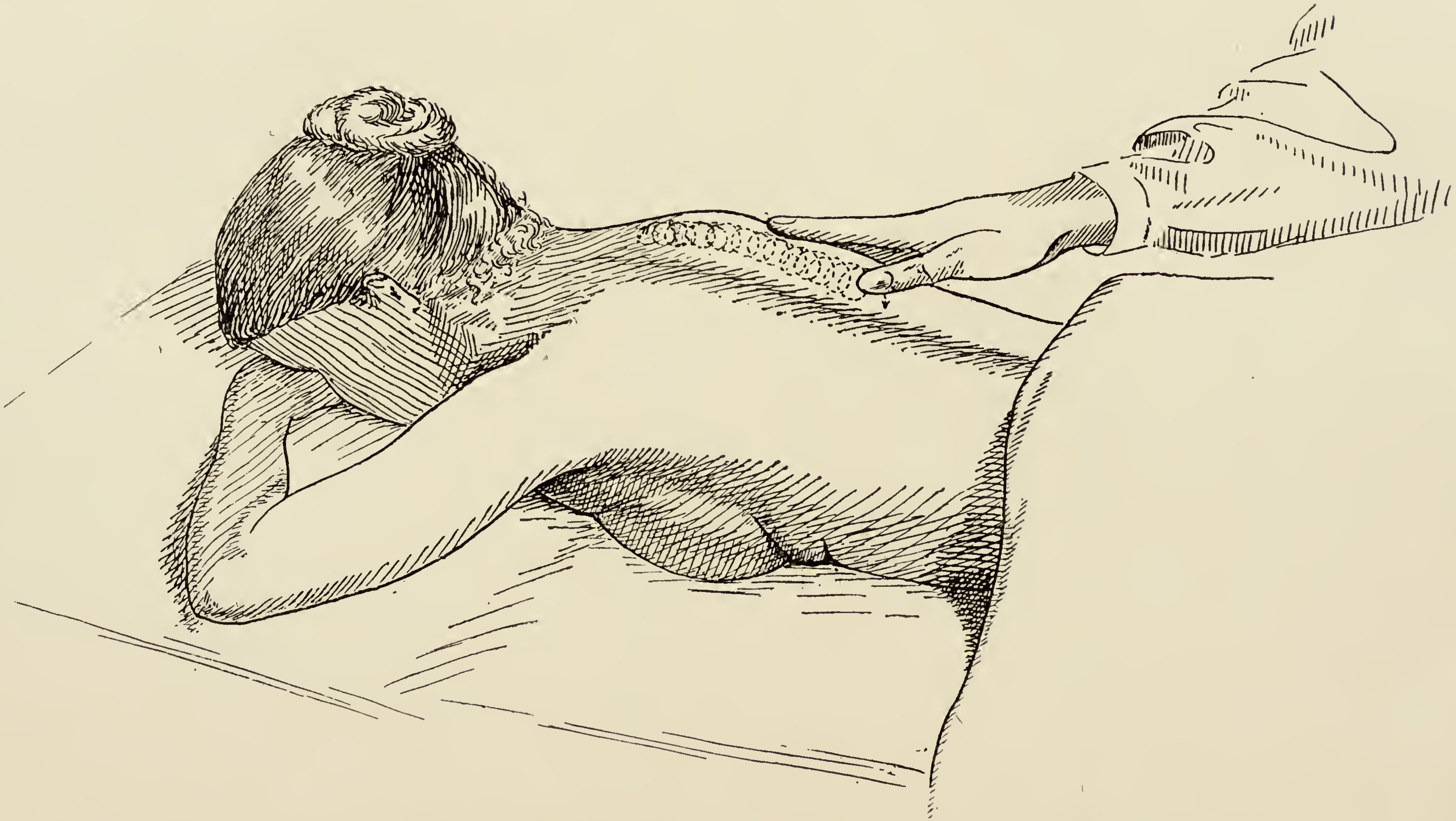

Plate 102.—Friction on the Long Muscles of the Spine.

3. With both index-fingers working alternately, a firm to-and-fro movement is made from the seventh cervical vertebra down, between the spinous processes on the supraspinous ligament.

4. Kneading with heel of hand all over the back from the spine outwards.

5. Hacking.

6. Flail.

7. Clapping.

8. Rolling effleurage, pressure towards axillary glands.

For the chest (the patient lying supine):

1. Kneading with heel of hand or ends of fingers on pectoral muscles from middle line outward.

2. Thumbs drawn with pressure over intercostal outward from middle line.

3. The hands rest on the chest, fingers pointing to neck. The patient breathes deeply against their resistance.

4. Stroking from sternum to pubes many times, over recti muscles.

5. Kneading of recti muscles with fingers and thumbs.

Exercises (still lying on back).—1. Outward circumduction of extended arms.

2. Artificial respiration (Sylvester's method).

3. A simple exercise of Blaikie's is good, the patient standing with knees straight, one foot in advance of the other, arms folded at the back, head drawn back, chin tipped till the eyes look at the ceiling over the head; rest a few moments, say while two or three deep breaths are taken, straighten trunk and repeat.

This movement expands the chest and straightens the back, and may be made more effective by resistance being made with the hand of the operator against the back of the patient's head. All the muscles of the neck are also strengthened.

Before turning on the back the patient might do a movement which strengthens the erector spinæ. The ankles are held, while the patient raises the head and shoulders from the couch, backwards; repeat. This may also be done with the head and trunk hanging over the end of the couch. Sponging the back with cold water, or with first hot and then cold water before the massage is given is helpful. Lateral curvature is often associated with posterior.

In **anterior** curvature the back bends inwards, at the lumbar and lower dorsal region, making a 'hollow back.' It is caused by hip-joint disease, talipes equinus, paralysis and rickets. The muscles of the back are shortened in this curvature, and the muscles of the abdomen are lengthened. It is very awkward to work on a back deformed in this way, it being difficult to get hold of the contracted muscles; any movements that can be made available may be used. The glutei are well kneaded, the back of the thighs, and the muscles of the abdomen.

Exercises.—1. Patient, lying on back, to rise into sitting position without aid of arms; return slowly and repeat. This exercises the recti abdominis, psoas and iliacus muscles.

2. Lying on back, knees straight, legs are raised to a right angle with the trunk; the psoas, iliacus and extensors of the thigh are thus strengthened.

3. Circumduction of extended leg to act on all muscles of the thigh.

4. Patient standing, knees straight, feet a little apart, arms elevated with fingers touching, to bend trunk from hips till the fingers are as near the floor as possible. Raise trunk with arms in same position; repeat.

In this exercise, the erector spinæ, the recti abdominis, the glutei, psoas, iliacus, and quadriceps extensors are brought into use.

Lateral curvature with or without rotation is the one which principally concerns the masseuse, because, though round backs are very common, massage is not so commonly ordered for them, and because posterior curvature frequently develops lateral, and for the latter treatment is sought.

The spine bends sideways; there may be a long **C**-shaped curve reaching from the upper dorsal to the lumbar region, or there may be a short curve in any part of the column with a secondary or compensatory curve above or below it, making the spine **S**-shaped, or there may be three or more curves.

There are a great many theories as to the cause of lateral curvature, which it is unnecessary to go into.

Softness of the bones, general weakness, weakness of the muscles of the back and ligaments of the spine predispose to it. The exciting causes are faulty positions, such as standing continually on one leg, sitting with always the same leg crossed on the other, sitting sideways or at too low a table when writing or studying, continued over-fatigue; or it may be caused by a short leg, the loss of a limb, paralysis, flat foot, wry neck, or diseases altering the shape of the thorax.

The curve may be to either side, and in the sigmoid it is to both sides.

The dorsal curve in the majority of cases has the convexity to the right, and the lumbar curve the convexity to the left. Where there is structural defect, as in a short leg, the legs must be made equal by a thick sole to one shoe; in flat foot properly constructed shoes are worn, and so on, but these things are of course arranged by the surgeon. What is required from the masseuse is that she should strengthen the weak muscles of the back and so enable them to pull the spine straight, and that she should instruct and encourage the patient to correct any faulty position. She may commence her work with full confidence of a successful issue; the very worst cases are improved even where there is structural defect. Where the trouble is purely functional a complete recovery may be counted on, which is not wonderful if one considers that weak and wasted muscles are nourished and exercised. But if this happy result is to be brought about by the efforts of the masseuse the work must be well and intelligently done, the anatomy of the spine and pelvis and the action of the muscles understood. When a surgeon sends a masseuse to a case it is in the belief that she understands her work, and it behoves her to do so, as he may give her no definite directions. It is impossible before a back is seen to know exactly what work is required, for there is much difference in the number and nature of the curves. There may be deviation without rotation, or deviation with more or less rotation, or rotation without deviation or with scarcely perceptible deviation, or a deviation so slight that only a trained and accustomed eye can detect it. To take the last-named first, the manipulations used in posterior curvature are suitable, that is, they are symmetrical; there is not sufficient stretching of muscles to require a difference of movements on either side. The work on the abdomen to be omitted.

Exercises.—1. Head and trunk hanging over end of couch (ankles being strapped or held by operator) to be raised to the horizontal or beyond it.

2. Lying on back, arms by sides, forearm to be flexed on arm, fingers straight, and to touch outer side of shoulder.

3. Arms elevated, brought down with forearms flexed on arms; arms extended outwards, forearms flexed on arms.

4. Circumduction of extended arms.

5. Circumduction of extended legs.

These movements exercise all muscles of the back, chest, arms and legs.

They may at first each be repeated three times, then five, then ten. The patient should breathe deeply during each exercise.

In a more advanced case the condition is evident, and the asymmetry immediately strikes one. Suppose a case without rotation, with dorsal curve to the right and lumbar curve to the left—the right shoulder is raised, the left is depressed; the right hip is depressed, the left is prominent; there are thus two protuberances and two depressions. The patient lies prone, without a pillow under the head, and with one under the stomach. The arm of the depressed shoulder is elevated and close to the head, the arm of the raised shoulder is depressed and close to the side; in this position the curves appear much less or disappear altogether, and the muscles of the back are relaxed. The movements described for the back in the ordinary way are first used, and are followed by friction and effleurage over muscles in the vertebral groove, and the to-and-fro movement on the supraspinous ligament as in posterior curvature. Care must be taken to get at the deep muscles; at the same time, pressure on the concavities must be avoided. The work must be modified to suit the altered shape of the back.

The convexities are kneaded with the heel of the hand, the depressions with the ends of the fingers, the muscles well moved about with the cushions of the fingers of one hand kept straight with the fingers of the other hand, no pressure made on the bones.

Tapotement by hacking.

Flail.

Clapping.

Exercises.—1. Head and shoulders to be raised from couch as before.

2. Circumduction of left arm.

3. Circumduction of right leg.

4. Standing. Left arm elevated, forearm flexed and pronated over head, fingers touching opposite ear, right arm depressed, trunk bent as far as possible to right side, knees straight, both feet kept on floor.

For left dorsal curve these positions are reversed.

5. Knees straight, one foot in advance, arms elevated, fingers touching, to bend forward till fingers touch floor, or as far as possible; rise slowly to first position.

In lateral curvature with **rotation** the spine has not only deviated from the middle line, but some of the vertebræ have turned or twisted; that is, the spine has curved with the convexity, say to the right, in the dorsal region; the bodies of the vertebræ, having more freedom of movement than the processes, turn more to the right than the processes do; the consequence is that the left lateral processes are carried downwards with their attached ribs; this causes a sinking of the muscles that are supported by these ribs, the spinous processes turn towards the concavity thus made, the right lateral processes are raised with their attached ribs, and much deformity is the result. In the lumbar curve there are no ribs, but the muscles are bulged out on one side and sunken on the other. The appearance of the back is quite different to the one last considered, and there is a difference in the appearance of backs with even the same class of curvature. Each one must be critically examined before being worked on.

The position of the patient is prone; it may be necessary to put a small pillow or pad under a shoulder or hip, and to further relax the muscles of the concavity; if still difficult to get at, the patient may turn somewhat on the other side, with the trunk slightly curved for the moment. In rotation, which is true scoliosis, the curves are not lessened in the prone position ; the protrusion of the shoulder and hip are frequently on the same side ; the ribs are very prominent on the convex side, forming a bow at the back ; the intercostal spaces are widened. In front the ribs are depressed, the lower part of the sternum inclines to that side, the clavicle is crooked, and the shoulder is not only raised, but the scapula is pushed out and carried away from the middle line. On the concave side the ribs are depressed at the back, and the intercostal spaces are narrowed, the shoulder droops, and the ribs are more prominent in front ; the pelvis is tilted, the ilium on the side of the lumbar curve is thickened—in fact, the whole thorax and pelvis are deformed.

The work in such altered conditions necessarily differs from that used in mere deviation from the middle line. There should be more care exercised, *if possible*, for much harm may be done and rotation increased by making pressure in a wrong direction ; in these cases pressure on the bones is not only proper but necessary. The idea of raising the drooping lateral processes must be borne in mind, also the untwisting of the twisted bones. Friction with the thumb is done between the spinous and transverse processes on the convexity, but on the concavity it would tend to increase rotation by downward pressure.

In kneading with the heel of the hand from the spine outwards, pressure is made on the bulged-out ribs ; at the same time, the other hand should be placed under the depressed ribs, and they should be pressed upwards, the fingers underneath, as it were, lifting them, so that while working a moulding or straightening process is kept up. When kneading the depressed side the work should not be commenced at the spine as usual, but at the side and terminating at the spine, the other hand resting with pressure on the convexity ; in this way pressure on the concave side is guarded against, and pressure on the convex side is insured. All the movements for the back that can be made available may be used ; some are suitable for one part and not for another.

Pressure with thumbs outwards on the intercostal spaces may be made on the convex side, also pressure with thumbs upward on the lower side of the spinous processes, tending to bring them into better position. On the concave side the muscles lying in the vertebral groove are worked with an upward pushing movement of the thumbs towards the spinous processes. It is of the highest importance that the condition of the spine, ribs, etc., should be understood by the masseuse.

In all cases of curvature the chest muscles must be manipulated and exercised; the same care must be taken to avoid pressure on the depressed side.

When the elevated arm becomes fatigued it should be depressed.

The object in the special exercises used in rotation of the vertebræ is to draw the spinous processes into place, and thus correct the rotation. The transverse muscles having their insertions in the shoulder and humerus—that is, the trapezius—the rhomboids and the upper part of the latissimus dorsi are attached to the spinous processes; therefore these muscles should be exercised on the side of the dorsal convexity, while the chest muscles are exercised on the side of the concavity in order to draw the too prominent side of the chest back. The long muscles, the erector spinæ and multifidus spinæ, should be specially studied in connection with curvatures.

Exercises.—1. Lying on back. Circumduction of right arm forwards alternately with circumduction of left arm backwards.

2. Circumduction of left leg.

3. Sitting. Right arm across chest, hand on left shoulder, left arm crossed at back. Deep breathing five times.

4. Head slowly rotated from right to left as far as possible.

5. Left arm crossed at back, trunk slowly rotated as far as possible to the left.

6. Operator to press summit of curve while patient elevates and extends backwards the left arm.

7. Standing. Both arms extended forwards and to the right, to be moved quickly across as far as possible to the left.

8. Right hand on ribs under armpit, fingers pointing to spine, left arm flexed over head, fingers touching right ear, bend shoulder as far as possible over right hand. Breathe deeply five times.

For dorsal curve to the left all manipulations and exercises to be reversed.

9. Lying on face, head and shoulders to be raised from couch, or, if lying over end of couch, to be raised to or beyond the horizontal. Deep breathing. To be repeated three times.

10. Standing. Arms elevated, knees straight, to bend trunk till fingers touch the floor, return to first position; repeat three times.

These exercises are, for the most part, at first *passive*, then *active*, later on *resistive*.

The patient must not turn or twist the body in making or overcoming resistance.

The exercises may be given with Whiteley's, Dowd's, or any of the exercisers now in use, providing that the action of the muscles concerned and the anatomy of the spine and pelvis are understood.

Dumb-bells may be used in arm exercises with advantage.

Breathing exercises are most important.

The same rule applies here that is followed in the limbs; the weakest muscles are sought out and strengthened before exercises are commenced. A patient with spinal curvature is very easily fatigued, and fatigue is most harmful in such cases; there must therefore be discretion used in giving treatment, beginning with fifteen minutes and gradually lengthening the time. The surgeon fixes the maximum.

In cervical curvature the exercises used in wry-neck are suitable.

Spinal curvature is one of the cases in which the patient should rest in a recumbent position after massage. From half an hour to an hour is long enough. If a corset or any form of support is worn, it should not be replaced till after the rest. Flat foot is frequently associated with curvature.

The **erector spinæ** consists of seven muscles, which extend from the pelvis to the back of the head. It arises from the back part of the crest of the ilium, the posterior iliac spines, nobs of sacrum, all the sacral and lumbar, and two or three lower dorsal spines. Below the last rib it divides into two columns.

The **sacro-lumbalis** is the *outer* column; it inclines outward, and is inserted by tendons into the lower six or seven ribs near their angles. This muscle is continued upwards by the **musculus accessorius**, which arises internal to it from the upper border of the lower six ribs, and is inserted by tendons into the angles of the upper six ribs and the transverse process of the seventh cervical vertebra.

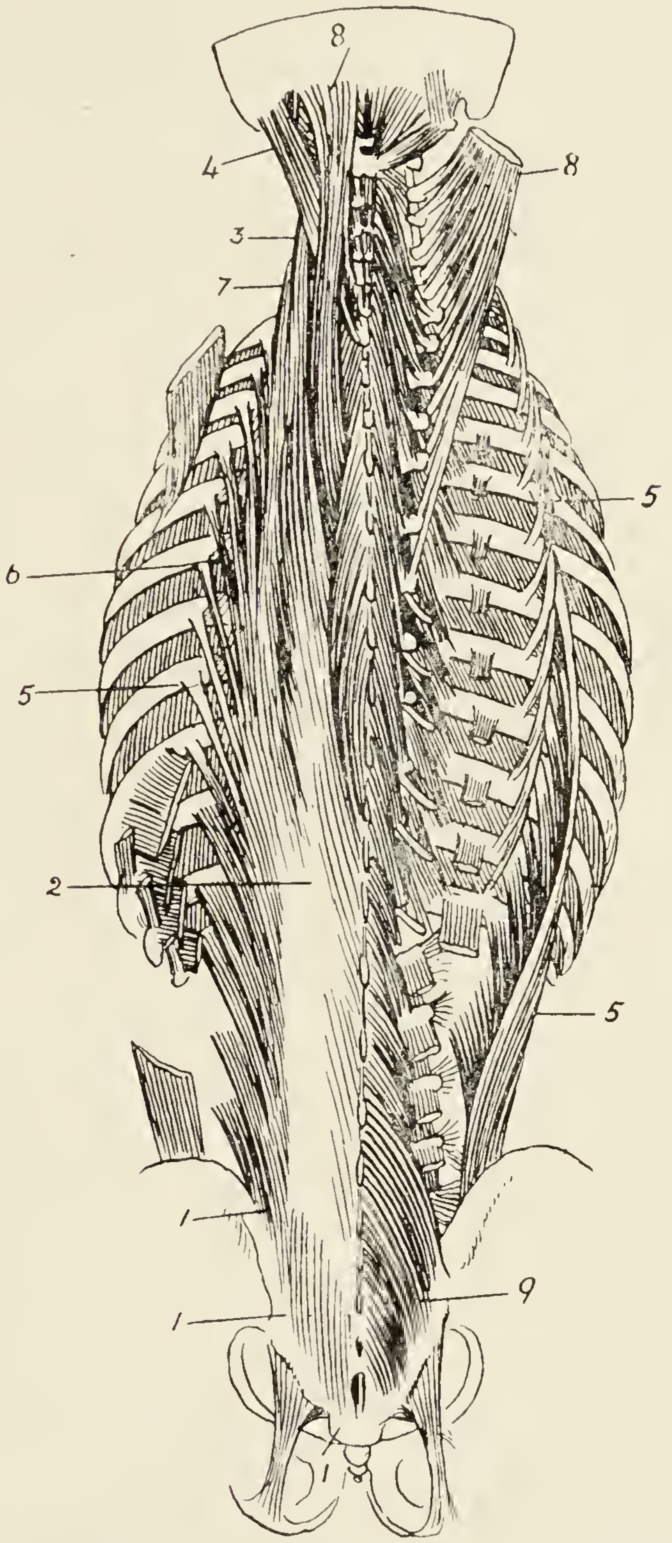

FIG. 103.—1, Origin of erector spinæ muscle; 2, longissimus dorsi; 3, transversalis cervicis; 4, trachelo-mastoid; 5, sacro-lumbalis; 6, accessorius; 7, cervicalis ascendens; 8, complexus; 9, multifidus spinæ.

The **cervicalis ascendens** arises from four or five upper ribs internal to the accessorius, which it continues upwards, and is inserted into the transverse processes of the fourth, fifth, and sixth cervical vertebræ.

The **longissimus dorsi** is the *middle* column; it is inserted by tendons into the transverse processes of all the dorsal vertebræ and upper articular processes of lumbar vertebræ and to the lower nine or ten ribs, between their right angles and tuberosities.

This muscle is continued upwards by the **transversalis cervicis**, which arises from the transverse processes of the first four or five dorsal vertebræ, and is inserted into the transverse processes of the cervical vertebræ from the second to the sixth.

The **trachelo-mastoid** continues the longissimus dorsi to the head; it arises from the transverse processes of the four or five upper dorsal and the articular processes of the three or four lower cervical vertebræ, and is inserted into the mastoid process beneath the sterno-mastoid and the splenius.

The **spinalis dorsi**, which forms an *inner* column, separates from the longissimus dorsi in the upper dorsal region; it arises from the two upper lumbar and two lower dorsal spines, and is inserted into the dorsal spines from fourth to ninth.

It will be seen that these muscles overlap each other in the whole length of the trunk.

The **multifidus spinæ**, the most deeply seated of the spinal muscles, reaches from the sacrum to the axis; it lies in the vertebral groove beneath the erector spinæ and the longissimus dorsi, and arises in the first place from the back of the sacrum, the inner side of the superior posterior spine of the ilium, the sacro-sciatic ligament, and from the overlying tendon of the erector spinæ. In the lumbar region it arises from the upper articular processes of the vertebræ, in the dorsal region from the transverse processes, and in the cervical region from the articular processes of the four lower cervical vertebræ. It is inserted into the whole series of spinous processes, the muscular bundles overlapping each other as they pass from their origin upwards and inwards to their insertion in the spinous processes above them, some to the next process, and some missing one, two, or three processes.

CHAPTER XII

GENERAL MASSAGE

In general massage it is not necessary to use all the movements that have been learned. In manipulating, say, a paralyzed limb, more movements are used and more time given to it than to any one limb in the course of general massage. No special movements, such as those used in sprains, synovitis, etc., are called for.

The patient is prepared as in Chapter I.

The Foot.—Toes held in one hand, and the ends rubbed crosswise with the palm of the other hand, then flexed and extended *en masse*. The foot is taken between the two hands, effleurage is applied to sole and dorsum and to each side; it is then compressed between the hands several times.

The **ankle** is kneaded at each side with heel of hand, flexed and extended several times.

The Leg.—Effleurage on both sides and back, kneading with fingers and thumbs on calf, kneading with thumbs over tibialis anticus, and with heel of hand on the outer aspect.

Kneading with palms of both hands on all muscles.

Tapotement with fingers, rolling effleurage.

The Knee.—Kneading with heel of hand at each side and under. Effleurage in semicircular fashion.

The Thigh.—Effleurage over every aspect, kneading of all muscles with fingers and thumbs and with palms.

Tapping.

Beating.

Rolling effleurage.

The Hip-joint.—Kneading, effleurage.

Leg flexed on thigh, thigh flexed on abdomen several times.

Fulling and squeezing are omitted, but may be substituted for kneading with fingers and thumbs.

The Liver and **Stomach** as in Chapter VIII.

The Abdomen.—Any or all the movements according to circumstances.

The Chest.—The hands are placed under the night-dress on point of shoulders, drawn forward to middle line, down on sternum, turned under breasts; returned to shoulders in same way several times.

The Hands.—As feet.

The Arms.—As legs.

The Neck.—Effleurage and kneading with fingers and thumbs.

The Back.—The patient having turned, the back is done as in Chapter VIII.

A weak or nervous patient may require a drink of warm milk or beef-tea; she may remain in bed for half an hour or an hour, but this depends on circumstances.

The above order need not be invariably followed.

The time may be divided as follows:

Séance of one hour: legs twenty-five minutes, chest and abdomen fifteen minutes, arms ten minutes, back ten minutes.

Some doctors order massage in the following way: For some days effleurage only, then for some days pétrissage only, then both.

Before leaving a patient in bed, the masseuse should assure herself that someone is within call, or a bell within reach of the patient.

OBESITY.

In general massage for obesity all the movements are characterized by pressure, and may, broadly speaking, come under the head of pétrissage. On the limbs firm stroking, with the palms of both hands working simultaneously.

Pincement is substituted for thumb and finger kneading, the skin and superficial fascia being well rolled and squeezed.

Fulling is very suitable, especially when the fat is hard and the skin tight, not so much for the pressure, but because it stretches and moves the tissues on each other.

Squeezing.—Large masses are seized with *both* hands and squeezed.

The flexures of all joints where fat is wont to accumulate must receive special attention, being well worked into by friction, kneading, and firm effleurage. They must be flexed as thoroughly as possible, and extended to the utmost. After treating the abdomen in the usual way, the walls are treated to further and more vigorous kneading, pincement, and fulling.

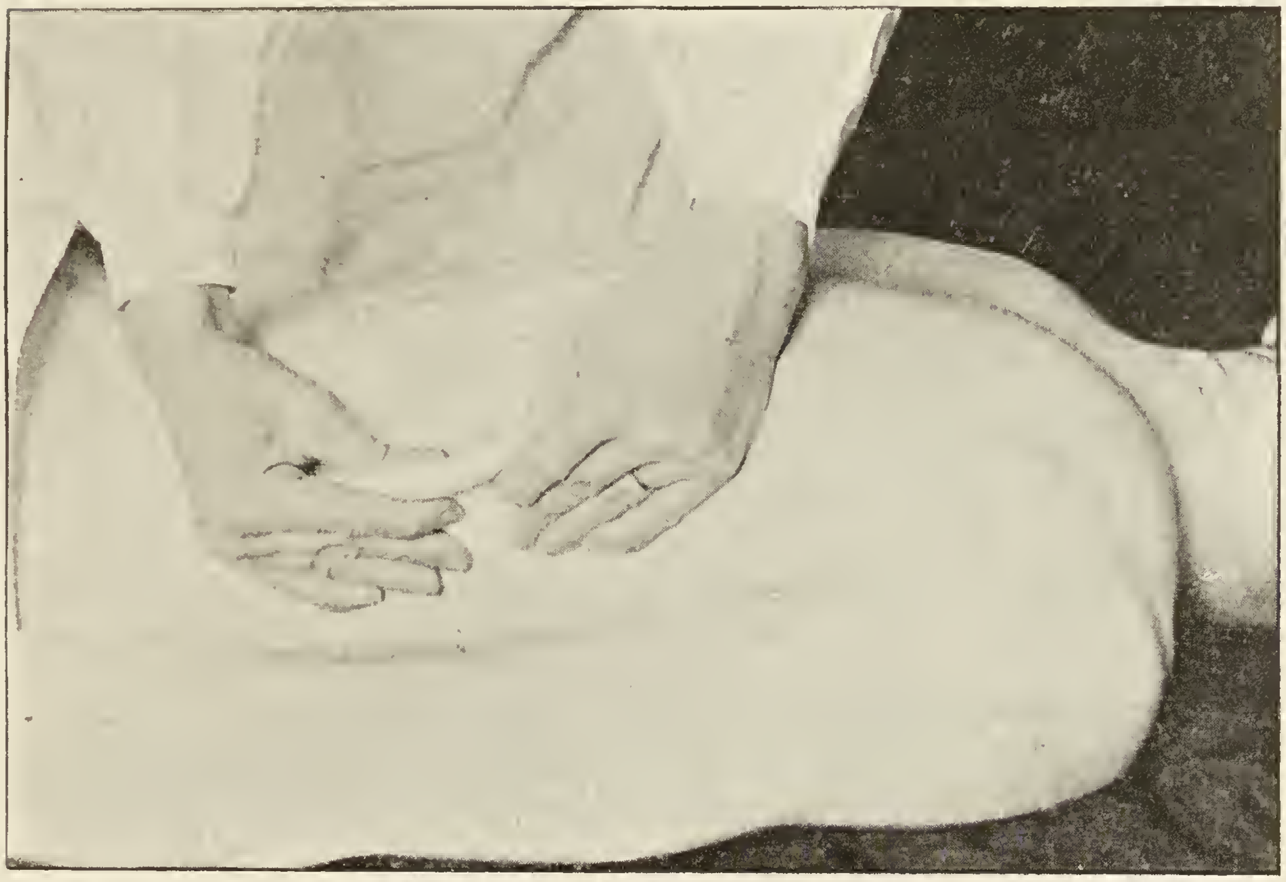

FIG. 104.—PINCEMENT.

For **neck** and **chin** pincement and effleurage.

The Back.—Effleurage with both flat hands, working together from neck to sacrum.

Kneading all over, from spine outwards, with thumbs and heel of hand.

Fingers placed at neck on one side of spine, thumbs on the opposite side, to be drawn towards each other, making two rolls of fat between; one hand follows the other down to sacrum.

Pincement in lines from neck down on each side of spine.

Hands laid flat, palms down, the left on patient's right

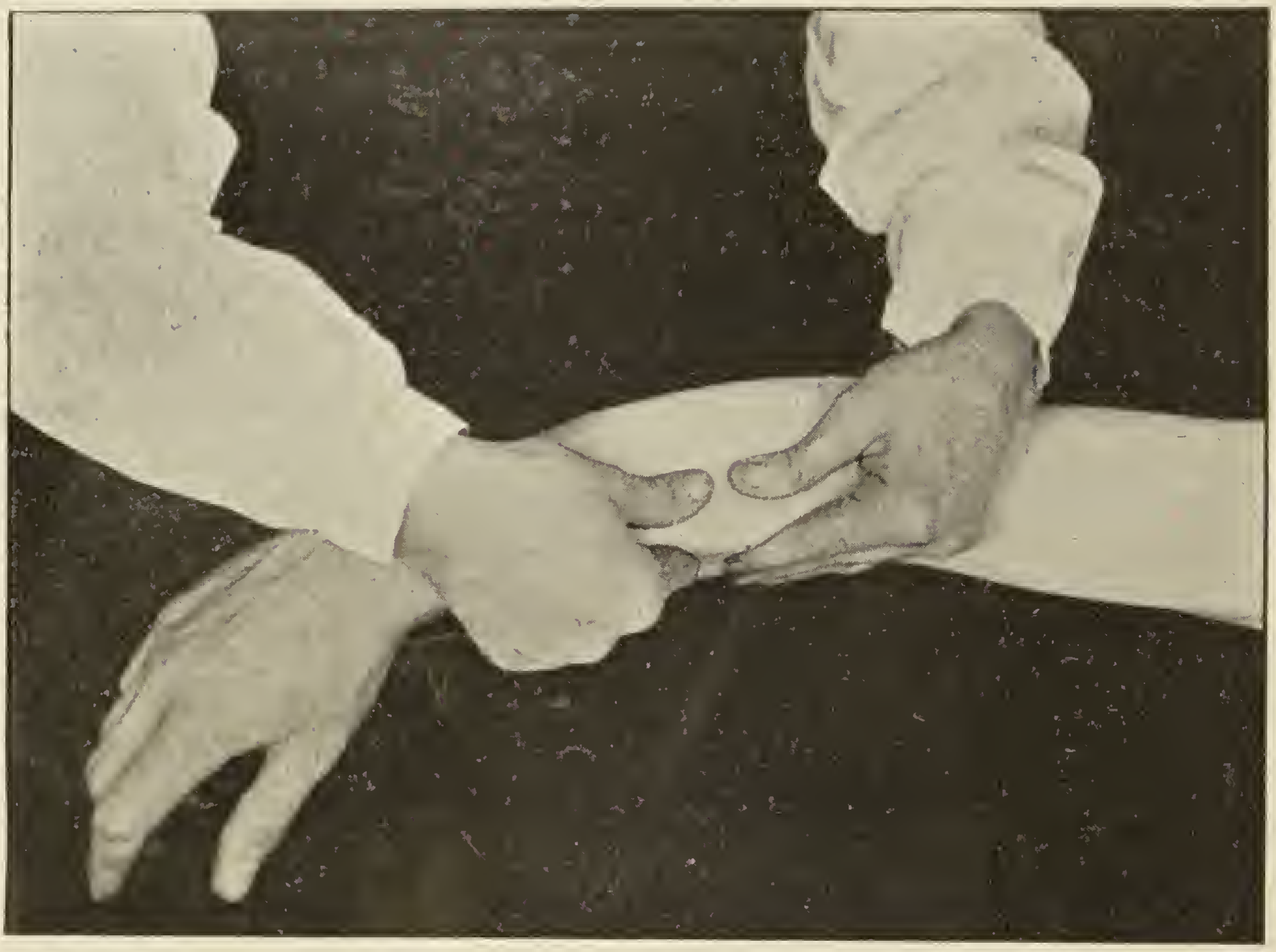

Fig. 105.—Pincement.

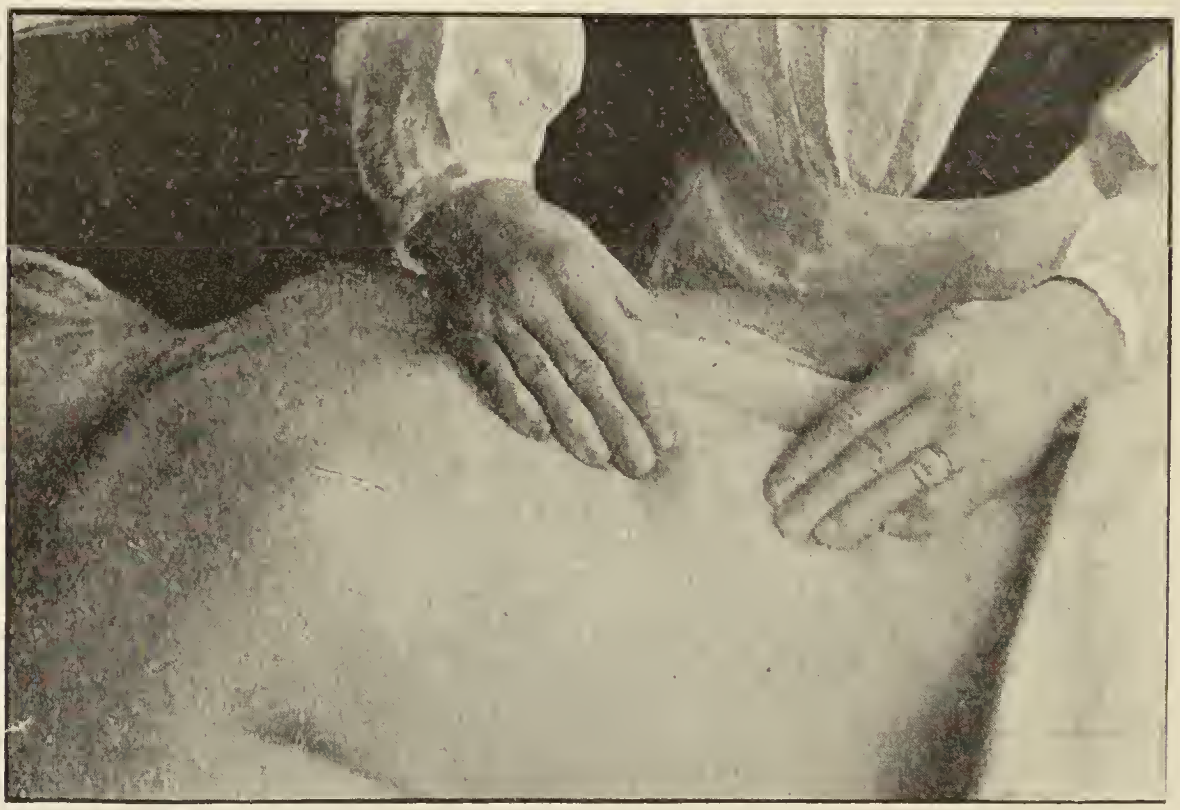

Fig. 106.—Squeezing Superficial Tissues in Obesity.

shoulder, the right on patient's left shoulder rather lower, fingers of both pointing from operator, who is supposed to be at patient's left side, left hand is drawn back while right is pushed forwards; this is repeated down the back, the hands passing and repassing each other, making a sort of twisting movement. Fairly firm pressure is used, but on the muscles, not on the skeleton.

Rapid and vigorous fulling.

Chopping, flail, clapping.

There is frequently a lump of fat at the back of the neck almost or quite devoid of feeling; this is pressed and squeezed.

All kneading movement to be used on buttock, also fulling.

Exercises.—1. Patient lying supine, to rise to sitting position without aid of arms.

2. All movements of legs and arms against resistance.

3. Body flexed laterally, backwards and forwards against resistance.

It must be borne in mind that these patients are physically unable to take sufficient exercise, and that one object in giving them massage is to make up this loss to them. It should, therefore, be of a vigorous and stimulating kind, and the exercises resistive; they should not remain in bed after treatment, but dress and move about immediately.

INSOMNIA.

If sleeplessness is caused by cold feet, as is often the case, massage of feet and legs to knees, fifteen minutes each, after the patient has retired for the night. If there be a sense of heat and fulness in the head, throat effleurage is added for five minutes, soothing movements over head and forehead. Circumduction of arms.

If caused by nervous restlessness, inability to lie still, general effleurage of limbs, circular effleurage on spine, and soothing movement on head.

General massage for forty minutes after the patient has retired, by regulating the circulation, induces sleep without special movements. A warm, not *hot*, drink after treatment helps.

THE WEIR-MITCHELL TREATMENT.

This treatment consists of **isolation, rest, excessive feeding, massage,** and **electricity**. The two latter are given to counteract the ill-effects which would otherwise result from complete rest and much feeding. If a patient is kept in bed and fed at short intervals for weeks, some means must be adopted to make up for the loss of habitual exercise, which is inevitably massage and electricity. **Dr. Weir-Mitchell** of Philadelphia, the originator of the treatment, advises that, if possible, the treatment should begin at the close of the menstrual period.

At first the patient is not allowed to feed herself or to use her hands in any way. It is found that more food is taken if the patient is fed by the nurse. The nurse sponges the patient all over daily in bed.

After a fortnight the nurse is allowed to read aloud. Towards the end of the treatment, which may last six weeks or two or three months, the patient is allowed to sit up in bed and occupy herself with some light work ; she may also feed herself, the food being cut up for her ; then she is allowed to sit out of bed for a few minutes at bedtime. Later on she sits up for a quarter of a hour twice a day ; the time is gradually increased, till she rests on the bed for only about three hours a day. Massage is kept up all the time ; the time is gradually decreased towards the end, till it is given only three times a week, an hour each time. Half the time is given to Swedish exercises, to prepare for walking.

Feeding.—The patient is gradually put on milk diet, one quart daily in divided doses of 3 or 4 ounces. It may be warm or cold, and barley, rice or lime water added to aid digestion. A cup of black coffee, without sugar, is given in the early morning to regulate the bowels. In a couple of days the milk is increased to two quarts, in doses of 5 ounces ; later on, 10 ounces. Within a week the patient has soup and a light breakfast. Later on a mutton-chop at mid-day, then thin bread-and-butter three times a day (Dr. Weir-Mitchell advised butter to be used freely). Within a fortnight the patient has three full meals daily, besides two quarts of milk. Fluid extract of malt is given before each meal.

The diet list of one of Dr. Weir-Mitchell's own patients is interesting:

October 10th.—One quart of milk in divided doses every two hours.

11th.—7 a.m., cup of black coffee. Two quarts of milk in doses of 5 ounces.

12th to 15th.—The same.

16th.—Soup added.

17th to 18th.—Ditto.

19th to 22nd.—Patient took each day: 7 a.m., coffee; 7.30, 5 ounces of milk; 10, ditto; 11, soup; at 12, 2, and 4, milk; 5, soup; 6 and 8, milk; 9, soup; 10, milk.

23rd to 27th.—Coffee, 7 a.m.; 8, egg and bread-and-butter for breakfast; diet as before the remainder of the day.

28th and onward.—7 a.m., coffee, iron and malt; 8, breakfast, chop, bread-and-butter, glass and a half of milk; 11, soup; 2, iron and malt, dinner of anything fancied, including 6 ounces of Burgundy or dry champagne, and finished with one or two glasses of milk; 4, soup; 7, iron and malt, bread-and-butter, fruit, and two glasses of milk; 9, soup.

At 12 noon daily, massage for one hour; at 4.30, electricity for one hour.

This treatment was continued to the sixth week, when soup and wine were discontinued, iron lessened to one-half, massage and electricity given on alternate days.

On the ninth week massage and electricity ceased, milk was reduced to one quart, and the patient drove out. 'The cure was complete and permanent.'

The same routine is not followed in every case. Sometimes cream is added; at other times the milk must be thoroughly skimmed. When patients are dyspeptic, nothing but skimmed milk is given the first fortnight.

Some patients take three quarts of milk daily with ease. They are always ready for food, no matter how much is given to them. A case given by Dr. Playfair proves how much can be consumed by these patients. For six weeks the diet was as follows: 6 a.m., 10 ounces of raw-meat soup; 7 a.m., cup of black coffee; 8 a.m., plate of oatmeal porridge, with a gill of cream, a boiled egg, three slices of bread-and-butter, and cocoa; 11 a.m., 10 ounces of milk; 2 p.m., ½ pound of rump-steak, potatoes, cauliflower, a savoury omelette, and 10 ounces of milk; 4 p.m., 10 ounces of milk and three slices of bread-and-butter; 6 p.m., a cup of gravy soup; 8 p.m., a fried sole, roast mutton (three large slices), French beans, potatoes, stewed fruit and cream, and 10 ounces of milk; 11 p.m., 10 ounces raw-meat soup.

As massage is the only exercise the patient gets, it should be vigorous. Special attention must be given to abdominal massage, to enable the digestive organs to cope with the quantities of food taken. 'Tender spots,' frequently complained of, may be avoided at first and gradually encroached on. The operator should not forget that moral massage is needed in these cases, and that the idiosyncrasy of each patient should be carefully studied. At first massage is given for twenty minutes, morning and evening; after three days it is increased to thirty minutes, then forty minutes. By the second week it has reached one and a quarter hours twice a day.

The urine of the patient should be watched as the food is increased; if any precipitation of urates appears, the amount of food should be lessened till the sediment disappears.

Raw-meat sandwiches are frequently ordered. To make them: Thin bread well buttered; finely-shred raw lean beef, seasoned nicely with pepper and salt; anchovy sauce or lemon-juice may be added if liked. The edges of the bread should be neatly closed that the meat may not show between.

Raw beef-juice is also often ordered.

Finely shred raw lean beef; place it in a jar with cold water and a little hydrochloric acid, in the proportions of 1 pint of water and 5 drops of acid to 1 pound of meat. Let it stand for some hours—eight to twelve—in a cool place; then place the jar in a vessel of hot water, 100° F., for two hours; strain through a cloth, and give as ordered. Porridge is found useful.

The rest cure is often much modified. An over-tired but not necessarily neurotic or hysterical patient is sent to bed in her own home for a month, or even two or three weeks. She is fed as above, and has massage once or twice daily; is kept quiet, but not isolated; is allowed to read and to receive letters, but not visitors. She sees her own family, gets up to her bath, etc., and at the end of the time returns to her duties with renewed strength and energy.

CHOREA.

This is another disease for which the rest cure is beneficial; the patient is kept in bed, and regularly fed, and has massage twice daily from fifteen to thirty minutes. The massage is gentle, effleurage in all its varieties; circular effleurage soothes these patients in a marked manner. It is well to begin the séance with circular effleurage on the spine, from neck to sacrum. When the muscles are somewhat under control, active exercises are commenced, the patient being got to concentrate her will on the regularity and evenness of the movements. Later on, as improvement takes place, *resistive* movements and pétrissage are added.

Tapotement is not advisable, as it tends to excite the patient and increase the nervous movements.

It is difficult to do perfectly even movements with a patient continually moving about.

CHAPTER XIII

MASSAGE OF CHILDREN

ACUTE ANTERIOR POLIO-MYELITIS OR INFANTILE PARALYSIS.

THE masseuse has to do with paralysis, atrophy of muscles, and deformities that result from this disease, but it is interesting to know a little about the disease itself. The paralysis is caused by the destruction of the nerve cells in the anterior horns of the spinal cord, chiefly in the cervical and lumbar regions.

During dentition, or after influenza or chill, or over-fatigue, the child has a rise of temperature, is languid and fretful, and develops paralysis of one or more limbs. This first stage is sometimes so little out of the ordinary that it is scarcely noticed till it is seen that the child drags a leg (if it walks or crawls), or does not move an arm.

In a short time there is partial recovery of the limb or limbs.

After this atrophy of the paralyzed muscles sets in, and deformity results.

In the first stage there is inflammation of the anterior horns of the cervical and lumbar portions of the spinal cord, with effusion of blood.

In the second stage there is absorption of the blood and products of inflammation, and some repair of damage by the formation of new nerve-cells.

Lastly, there is permanent paralysis of muscles which are supplied by the nerve centre which has been destroyed. The bones also atrophy and become short.

A peculiarity of the disease is the erratic way in which it seizes on groups of muscles, single muscles, or some fibres of muscle.

In the case of an arm, if it be the upper part, the deltoid may be so wasted that the arm hangs, as it were, out of the socket, and has a most deplorable and helpless appearance; the flexors of the forearm are also wasted, the bone seeming only to have folds of skin hanging therefrom.

Sometimes the extensors of the wrist and fingers are affected, and there is wrist-drop and claw fingers.

In the case of the lower limbs every joint may be lax, the thighs seem to drop from their sockets, the knees hang as if they were devoid of ligaments; there is foot-drop, and there seems to be absolutely nothing on the bones but skin and connective tissues hanging in loose folds. There is no more pitiable sight than a child with both legs in this condition, cold, blue, wasted, and powerless.

After a time, generally some months, the unaffected muscles assert themselves, and, being unopposed by their antagonists, pull the part out of position; hence deformities [such as talipes equina, and talipes varus and valgum, and, where one side of the erector spinæ muscle is paralyzed, spinal curvatures.

Massage does not cure infantile paralysis, but it is the chief agent in increasing the circulation, which is very bad in the affected limb, maintaining nutrition, strengthening muscles, preventing deformity, and preparing the paralyzed part to respond to the action of the nerves as repair takes place in the cord.

This repair is very slow, and the masseuse must be content to go on with her work patiently month after month, and it may be year after year.

All movements used must be modified in the case of a child; the hands cannot be used in the same way as on the limbs of an adult.

The best way to apply effleurage is with the thumb parted from the fingers (No. 4, p. 10). On a very small limb the thumb and index-finger only can be used; with these the ankle or wrist is encircled, and the stroke is carried up to the hip or shoulder, as the case may be. The wringing movement (No. 5) is a good one to use in pétrissage, and again it may be possible to use only the thumb and one finger. Pincement is also suitable, for although it is the principal movement used in obesity, it is also useful on very wasted muscle which cannot be kneaded in other ways; these poor, loose, lifeless tissues are taken up between the fingers and rolled and squeezed, as in No. 6, p. 12. Discretion must be used in beginning tapotement if the child is old enough to observe or to understand what is meant by being slapped for naughtiness. It is too stimulating a movement to be omitted. The masseuse may appear to make a game of it, saying, while she 'slaps,' 'Pat a cake, pat a cake, baker's man,' etc., or such like. All children get to love massage, but it is important not to give a fright at the start.

If there be deformity, the limb should be held in a correct position by the masseuse while she works, so that a continued stretching of contracted muscles and a moulding process goes on. The toes frequently turn under, and require particular attention. Babies do not always like having their toes interfered with, but recourse may be had to the oft-told tale of 'How *this* little pig went to market, and *this* little pig stayed at home.'

It is difficult to get a child of one or two years to lie on its face, so the back has to be done in a sitting position; astride on the lap of the mother or nurse and facing her is a good plan. Young children are happier on the mother's or nurse's lap during a séance. The paralyzed limb should have extra covering.

The ages of the little patients range from a few weeks to ten or twelve years. Ten minutes at a time is sufficient for quite a baby; with older children ten minutes to begin with, then twenty, then thirty. Thirty minutes is the maximum, five of which should be given to the spine, which it is always well to add to the local treatment.

Passive movements are used to all joints from the first; when some power of movement has returned assistive movements are added.

Inunction is useful in these cases. If it be ordered, the oil is rubbed in immediately after the massage manipulation.

Good results follow massage in post-diphtheritic paralysis.

Greenstick Fracture.—The principal movement is effleurage, the splints to be gently removed and carefully readjusted.

Separation of Epiphysis.—Massage is given after the parts are replaced. The treatment is the same as the foregoing.

Talipes (Club-Foot).—All movements for the foot and leg are given, and a continual moulding kept up, a gentle and gradual pulling of the foot into correct position. There are many varieties of club-foot, and the exercises given are those which are suitable to each individual case. The condition is due to contraction of certain muscles or tendons. In slight cases massage and exercises are relied on to bring about improvement. In severe cases they are given after operation.

In **talipes calcaneus**, the tendo Achillis is too long; there is contraction in the sole of the foot, and the toes do not come to the ground at the same time as the heel.

Treatment.—The muscles of the calf are well manipulated, and the foot is extended.

Talipes Equino-Varus.—The toes come to the ground, the heel is drawn up, and the foot is inverted.

Treatment.—The muscles on the front and outer aspect of the leg are especially worked up; the foot is flexed, abducted, and everted.

Talipes Equino-Valgus.—The toes come to the ground, the heel is drawn up, and the foot is everted.

Treatment.—Muscles on the front and outer aspect of the leg to be especially worked, the foot to be adducted and inverted.

In each case all the foot movements are useful, especially friction with thumb over tarsal-bones and round ankle-joints.

In giving exercises when the foot is flexed, extended, etc., it is held for two or three minutes in position, then the exercise is repeated.

If a retentive apparatus is used it must be applied carefully after treatment, care being taken that it is properly strapped.

Intussusception.—The movements over the tumour are made in a backward and forward direction—that is, the kneading is done from right to left in the ordinary way, then from left to right, passing and repassing over the invaginated part; one portion of the intestine has slipped over another. The idea of the double movement is to straighten out the bowel and push on the contents.

In spinal curvature, wry-neck and chorea, the treatment is the same as described in Chapters IX., X., and XII.

Delicacy of touch, cheerfulness of manner, and unbounded sympathy are essential qualifications in the masseuse who undertakes the treatment of the little ones.

GLOSSARY.

Abdo′men. Lower chamber of trunk.
Abdu′cens oc′uli. Muscle drawing eyeball outward.
Acetab′ulum. Cavity in os innominatum, like an old-fashioned vinegar-cup.
Acro′mion. Process on summit of scapula.
Ad′ipose. Fatty.
Af′ferent. Carrying from periphery to centre.
Alve′olus. An air cell; bone socket for tooth.
Anas′tomo′sis. Communication of branches of vessels.
Anco′neus. Muscle connected with triceps and olecranon.
Anti′cus. Anterior.
Aor′ta. Common trunk of systemic arteries.
Aponeuro′sis. Fibrous membrane.
Arach′noid (arak′noid). A covering of the brain, resembling spider's-web.
Are′olar. A form of fibrous tissue.
Artic′ular. Relating to joints.
Aryte′noid. A cartilage of the larynx.
Astrag′alus. A tarsal bone.
At′rophy. Wasting.
Auric′ulo-ventric′ular. Relating to the auricles and ventricles of the heart.
Az′ygos. Without a fellow.
Basil′ic. A superficial vein of the arm.
Bi′ceps. A flexor of the forearm.
Bicus′ped. Having two points; valve between left auricle and ventricle of heart.
Bifur′cate. To divide into two branches.
Bra′chial (bra′keal or brak′ial). Pertaining to the arm.
Buc′cinator (buk′sinator). A muscle of the cheek.
Cæ′cum. The blind pouch at the beginning of the large intestine.
Capil′lary (kapil′lary or kap′illary). Fine vessels, hair-like.
Cap′sule. A bag enclosing a part of the body.
Car′diac. Relating to the heart.
Carot′ids. Arteries conveying blood to the head.
Caud′a equi′na. Horse-tail.
Cerebel′lum. Lower part of brain.
Cer′ebrum. Upper and chief part of brain.
Cer′vical. Pertaining to the neck.
Coc′cyx (kok′siks). The lower part of the spinal column.
Cœ′liac (see′le-ak). Pertaining to the abdominal cavity.
Con′dyle. An articular process.
Cor′onary. Applied to ligaments and vessels that surround parts like a crown.
Cor′puscle. A small body, as blood corpuscle.
Cu′neiform. Wedge-like bones in wrist and foot.
Del′toid. A triangular muscle, resembling the Greek letter Δ.
Di′aphragm (dy′afram). Partition between thorax and abdomen.
Dor′sal. Pertaining to the back or the posterior part of an organ.
Duode′num. First part of small intestine.

Du′ra ma′ter. Hard mother, the outer covering of brain.
Ef′ferent. Carrying outwards as from centre to periphery.
Ef′fleurage (ef-flur-ahzh). Stroking.
Endothe′lium. Lining of vascular and serous cavities.
En′siform. Sword-shaped, lower end of sternum.
Epider′mis. Outer layer of skin.
Epiglot′tis. Cartilage behind root of the tongue.
Epiph′ysis (epif′isis). Portion of a long bone attached by cartilage.
Epithe′lium. Lining or covering of all surfaces of the body.
Fac′et. A small plane surface on bone for articulation.
Fas′cia. Fibrous membrane covering muscles.
Fe′mur. Thigh-bone.
Fibril′læ. Little fibres.
Fib′ula. Long thin bone of the leg, called the splint-bone.
Fol′licle. Small gland.
Fora′men, *pl.* **Fora′mina.** An opening or hole in bones.
Fora′men magnum. A large hole at the base of the skull.
Fora′men ova′le. An oval hole in the ischium.
Fos′sa. A depression.
Fun′dus. The base of an organ.
Funic′ulus. A little cord or bundle of fibres.
Gang′lion. A knot-like arrangement (which is also a nerve centre) in the course of a nerve.
Gastrocne′mius. A muscle of the leg.
Gladi′olus. Middle portion of sternum.
Glen′oid. A shallow cavity.
Glos′so-pharyn′geal. Pertaining to the tongue and pharynx—a cranial nerve.
Glute′us. Muscles forming the buttock.
Gly′cogen. Animal starch formed in the liver.
Hæmoglo′bin. Colouring matter of red corpuscle.
Haver′sian canals. Canals in bones discovered by Dr. Havers.
Hepat′ic. Pertaining to the liver.
Hi′lum. A small fissure or depression.
Hy′aline. Like glass, applied to cartilage.
Hy′oid. Bone at the root of the tongue, shaped like the Greek letter Υ.
I′leum. Third portion of small intestine.
I′liac. Pertaining to the ilium.
Ili′acus. Muscle arising in the iliac fossa.
I′lium. The upper portion of the os innominatum.
In′guinal (in′gwin-al). Pertaining to the groin.
Intersti′tial. Having interstices or spaces.
Is′chium (is′kium). The lowest portion of the os innominatum.
Jeju′num. Second portion of small intestine.
Ju′gular. Pertaining to the throat.
Lacte′al. Like milk, lymphatic vessels in the intestines.
Lar′ynx. Organ of voice.
Latis′simus dorsi. Broad muscle of back.
Leu′cocyte. White corpuscles.
Lin′ea al′ba. White line.
Lin′ea aspera. Rough line.
Lymphat′ic. Vessel carrying lymph.
Ma′lar. Cheek-bone.
Malle′olus. Ankle-bone.
Manu′brium, Upper portion of sternum.
Mas′sage (massazh). The scientific manipulation of the soft tissues of the body, kneading, pressing.
Masse′ter. A muscle of mastication.
Mas′seuse (mas′suse). A woman who applies massage.

Mas′toid. A nipple-like process.

Maxil′lary. Pertaining to the jaw.

Medul′la oblonga′ta. Part of the brain between the Pons Varolii and the spinal cord.

Mes′entery. A fold of peritoneum which attaches intestines to the posterior abdominal wall.

Metacar′pus. The part of the hand between the carpus and phalanges.

Metatar′sus. The part of the foot between the tarsus and phalanges.

Multifi′dus spi′næ. Muscles lying in groove of spinal column.

Neurilem′ma. Nerve-sheath.

Nu′chæ. Back part of neck.

Occip′ital (ok-sip′-it-al). Relating to the back of the head.

Odon′toid. A tooth-like projection on the axis vertebra.

Œde′ma. Effusion of serum into areolar tissue.

Œso′phagus. Canal from pharynx to stomach.

Olec′ranon. Process on the head of the ulna.

Omen′tum. A fold of peritoneum which connects the stomach with other viscera.

Orbic′ular. A circle applied to circular muscles.

Os, *pl.* **Ora.** A mouth.

Os, *pl.* **Ossa.** A bone.

Osmo′sis. Diffusion of liquids through membrane.

Os′sa innomina′ta. Bones of the pelvis, so named because of having no resemblance to any known object.

Ox′ygen. A colourless gas forming part of air, water, etc., and supporting life.

Pal′pebra. The eyelid.

Pan′creas. An accessory organ of digestion, the sweetbread of animals.

Papil′læ. Minute eminences on the surface of the body.

Pari′etal. Pertaining to a wall.

Parot′id. Glands near the ear.

Patel′la. The knee-cap.

Pectin′eus. Muscle rising from the os pubis.

Pec′toral. Relating to the chest.

Pep′sin. A ferment in gastric juice which converts proteids into peptones.

Pericar′dium. Serous membrane covering the heart.

Perichon′drium. Membrane covering cartilage.

Perios′teum. Membrane covering bone.

Periph′eral. That which is away from the centre and towards the circumference.

Peristal′tic. A worm-like movement of the intestinal tube by which the contents are propelled onward.

Peritone′um. The membrane that surrounds the abdominal viscera and lines the cavity.

Perone′al. Muscles or vessels in relation to the fibula.

Pé′trissage (pa′tris-sahzh). Kneading.

Phalan′ges. Bones of fingers and toes placed one beside another in rows like a phalanx of soldiers.

Phar′ynx. The cavity at the back of the soft palate.

Phren′ic. Pertaining to the diaphragm.

Pi′a Ma′ter. Tender mother, the inner covering of brain.

Plan′tar. Pertaining to the sole of the foot.

Plas′ma. The fluid in which the blood corpuscles float.

Platys′ma-myoi′des. A wide muscle of the neck.

Pneumogastric. Pertaining to the lungs and stomach.

Pons Varo′lii. 'Bridge of Varolius,' white fibres connecting the different parts of the brain.

Poplite′al. The ham.

Posti′cus. Behind.

Pro′teids. Albuminoid constituents of the body.

Pro′toplasm. Primitive organic cell-matter.

Pter′ygoid. A wing-like muscle.
Pty′alin. A ferment in saliva.
Pul′monary. Relating to the lungs.
Pylor′us. A gate or entrance, lower orifice of stomach.
Pyram′idalis. Like a pyramid ; name of two muscles.
Quadri′ceps. Extensor muscles of the leg.
Rhomboid′eus. A figure whose sides are equal, a muscle of the back.
Saphe′nous. Applied to two superficial veins and nerves in the leg, and to an opening in the thigh.
Sarcolem′ma. Covering of muscle fibril.
Sarto′rius. A muscle used in crossing the legs as a tailor does when at work.
Scale′nus. A muscle of the neck.
Scap′ula. The shoulder-blade.
Sciat′ic (syat′ik). Contraction of ischiatic, relating to the ischium.
Seba′ceous. Applied to glands secreting sebum or lard.
Se′rum. Watery fluid separated from the blood after coagulation.
Ses′amoid. Resembling a grain of sesamum.
Sig′moid. Like the letter S.
Sole′us. A muscle of the calf, shaped like the sole of a shoe.
Splanch′nic. Pertaining to the viscera.
Sple′nic. Relating to the spleen.
Sple′nius. A muscle of the back and neck.
Subcuta′neous. Under the skin.
Sym′physis. Union of bones.
Synchondro′sis. Union of bone by intervening growth of cartilage.
Syno′via. Lubricating fluid secreted by the synovial membrane in the joints.
Tapote′ment (tah-pote-ment). Percussion.
Tar′sus. The instep.
Ten′do Achil′lis. The common tendon of the gastrocnemius and soleus muscles attached to the heel.
Thorac′ic. Pertaining to the thorax.
Thy′roid. A gland in front of the larynx, a cartilage in the larynx, a hole in the innominatum.
Trache′a (trake′a). The windpipe.
Transversal′is. Applied to a muscle running in a transverse direction.
Trape′zius. A diamond-shaped muscle of the back.
Tri′ceps. Muscle with three heads.
Tricus′ped. Having three cusps or points.
Trochan′ter. Projection on the femur, to which rotators of the thigh are attached.
Troch′lea. A pulley-like process.
Tuberos′ity. A protuberance.
Umbili′cus. The navel.
Urea. Chief solid constituent of urine.
Ure′ter. Canal carrying urine from kidney to bladder.
Ure′thra. Canal carrying urine from bladder.
Vas′a vaso′rum. Bloodvessels which supply the walls of bloodvessels.
Vas′cular. Full of vessels.
Vas′o-constrictor. Nerve causing constriction of bloodvessels.
Vas′o-dilator. Nerve causing dilation of bloodvessels.
Vaso-motor. The vaso-constrictor and vaso-dilator nerves.
Venæ com′ites. Veins which accompany arteries.
Ver′tebræ. The bones of the spine.
Vil′li. Minute projections on the lining of the small intestines for absorbing digested food.
Vis′cera. Internal organs of the body.
Xy′phoid. Sword-shaped, lower part of sternum.
Zygo′ma. Arch formed by cheek-bones.
Zygomat′icus. A muscle of the cheek.

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THE END

Baillière, Tindall and Cox, 8, *Henrietta Street, Strand*

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